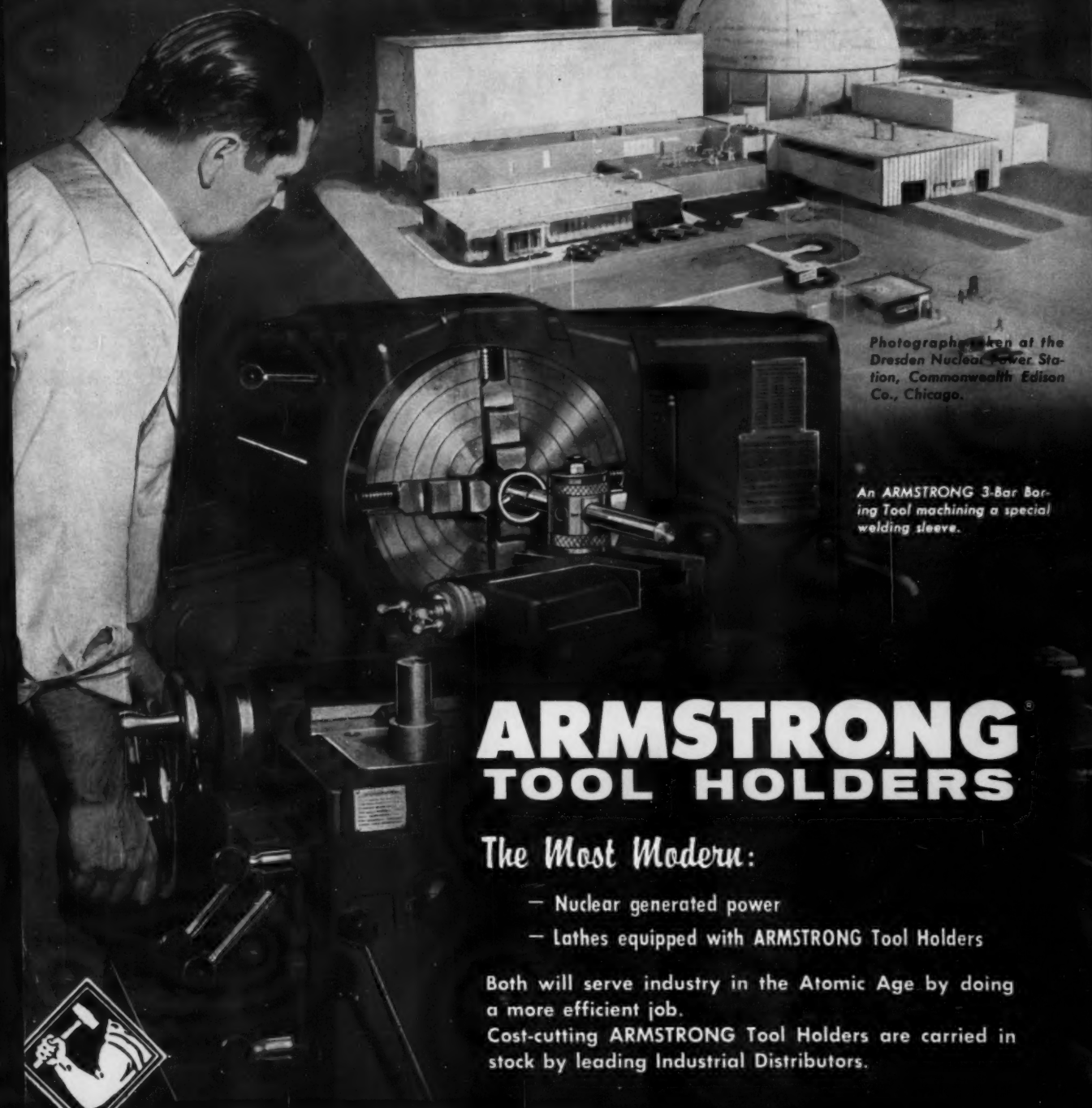


JANUARY 1960 - SIXTY-SIXTH YEAR

Machinery



Photograph taken at the Dresden Nuclear Power Station, Commonwealth Edison Co., Chicago.

An ARMSTRONG 3-Bar Boring Tool machining a special welding sleeve.

ARMSTRONG TOOL HOLDERS

The Most Modern:

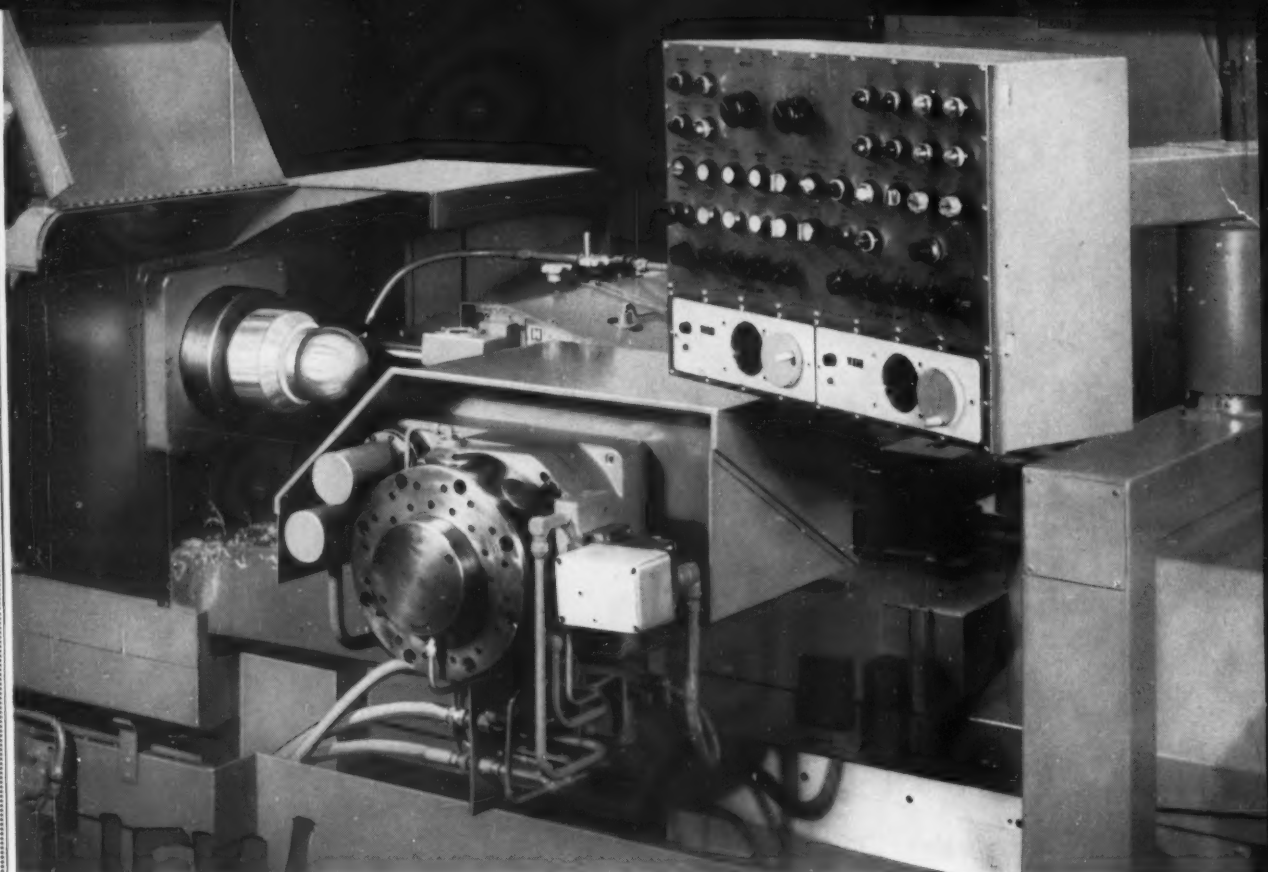
- Nuclear generated power
- Lathes equipped with ARMSTRONG Tool Holders

Both will serve industry in the Atomic Age by doing a more efficient job.

Cost-cutting ARMSTRONG Tool Holders are carried in stock by leading Industrial Distributors.



ARMSTRONG BROS. TOOL CO. "The Tool Holder People" **CHICAGO, U.S.A.**



This numerically-controlled Model S Bore-Matic operates in an air-conditioned, temperature-stabilized cubicle to maintain the extremely high precision of which the machine is capable.

NEW

TAPE-CONTROLLED BORE-MATICS

precision bore and turn free contours to $\pm .0001$ "

ON THE NEW, numerically-controlled Heald Model S Bore-Matics, free-form shaped parts are bored in production with a heretofore unattainable degree of accuracy and precision. Tool motion and work speed are automatically controlled throughout the entire cycle, in increments so small that contours are generated with a dimensional tolerance of $\pm .0001$ ". These Model S machines have been supplied in several sizes, with various types of numerical control, and are now in successful operation on a number of classified projects.

The machine shown above, with 20" table stroke and 15" cross slide travel, is arranged for punched tape control using Cincinnati Milling Machine

Company's Acramatic system. Table and cross slide are actuated by preloaded, re-circulating ball nut precision lead screws with hydraulic motor drive. Pressure lubricated box-type ways track to an accuracy of 25 millionths in 20 inches of travel. The specially designed work spindle turns within 30 millionths for total runout, and is driven by a cam-controlled variable speed unit arranged to maintain the proper cutting speeds for any given point on the workpiece contour.

For further details on numerically-controlled Model S Bore-Matics, contact your Heald engineer or write to The Heald Machine Company, Worcester, Mass.

It PAYS to come to Heald

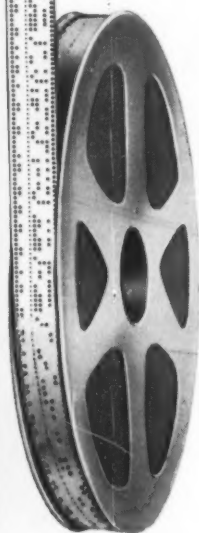
THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • New York • Philadelphia • Syracuse



MMT=PE



JANUARY 1960

VOL. 66 No. 5

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Machinery

**THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION
IN THE MANUFACTURE OF METAL PRODUCTS**

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Geared...
for customer
accommodation



Design and Delivery; Production Scheduling; Sales and Service; Engineering and Research; in every phase of our entire operation, our efforts are specifically primed for customer satisfaction.

And although Landis maintains the world's largest operation in its field, we know that size alone does not necessarily insure customer satisfaction. We know that *adequate* inventories, delivery when *promised*, service when *needed*, *skilled* engineering, continuous *research*, *precision* tools and machines, and personnel who *really* care are things that Landis' customers want, need, and expect. That's why we've set up our operation to supply those needs—supply them better, faster, more efficiently. And that's why Landis, with more than 50 years experience in designing, building, and servicing Threading Equipment, has become the acknowledged leader in its line.

If you are faced with the need of additional equipment for expanded threading operations, or new operations that require specialized design and engineering, or any problem concerning threading equipment or service—call LANDIS.

LANDIS Machine COMPANY

MARY HESBROOK • PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT



Threading Machines



Taps—Collapsible
& Solid Adjustable



Constant Thread
Grinding Machines



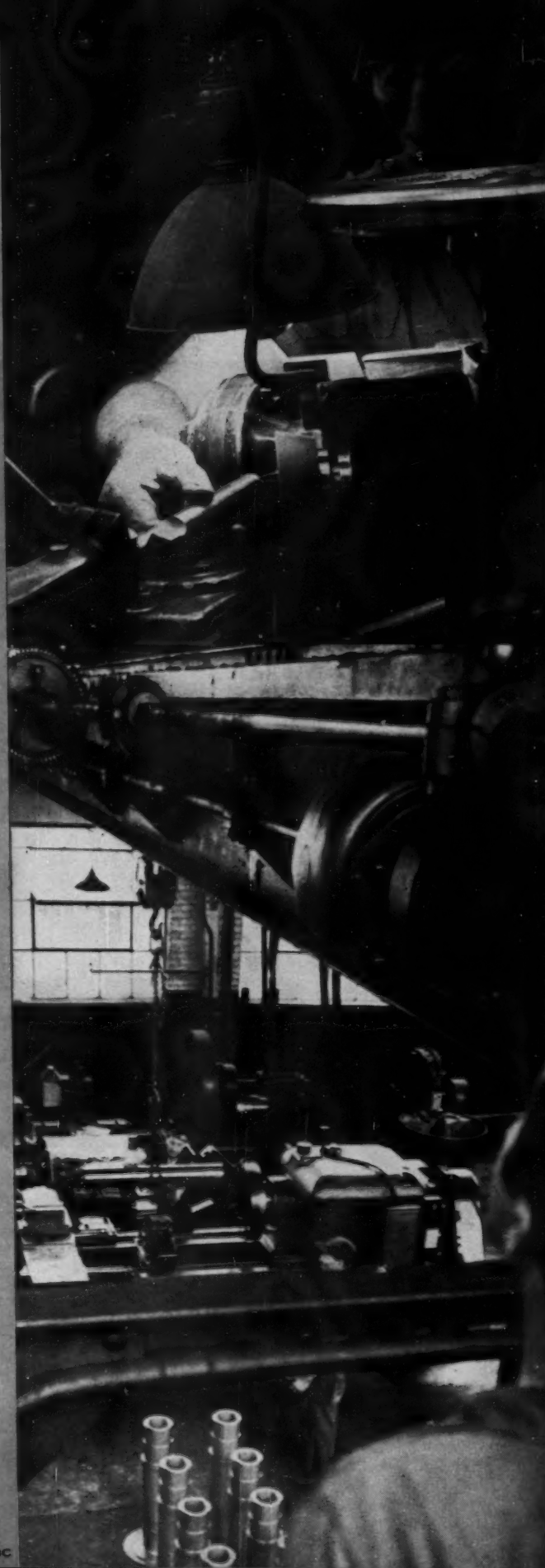
Thread Rolling Machines



Die Heads—
Index & Stationary

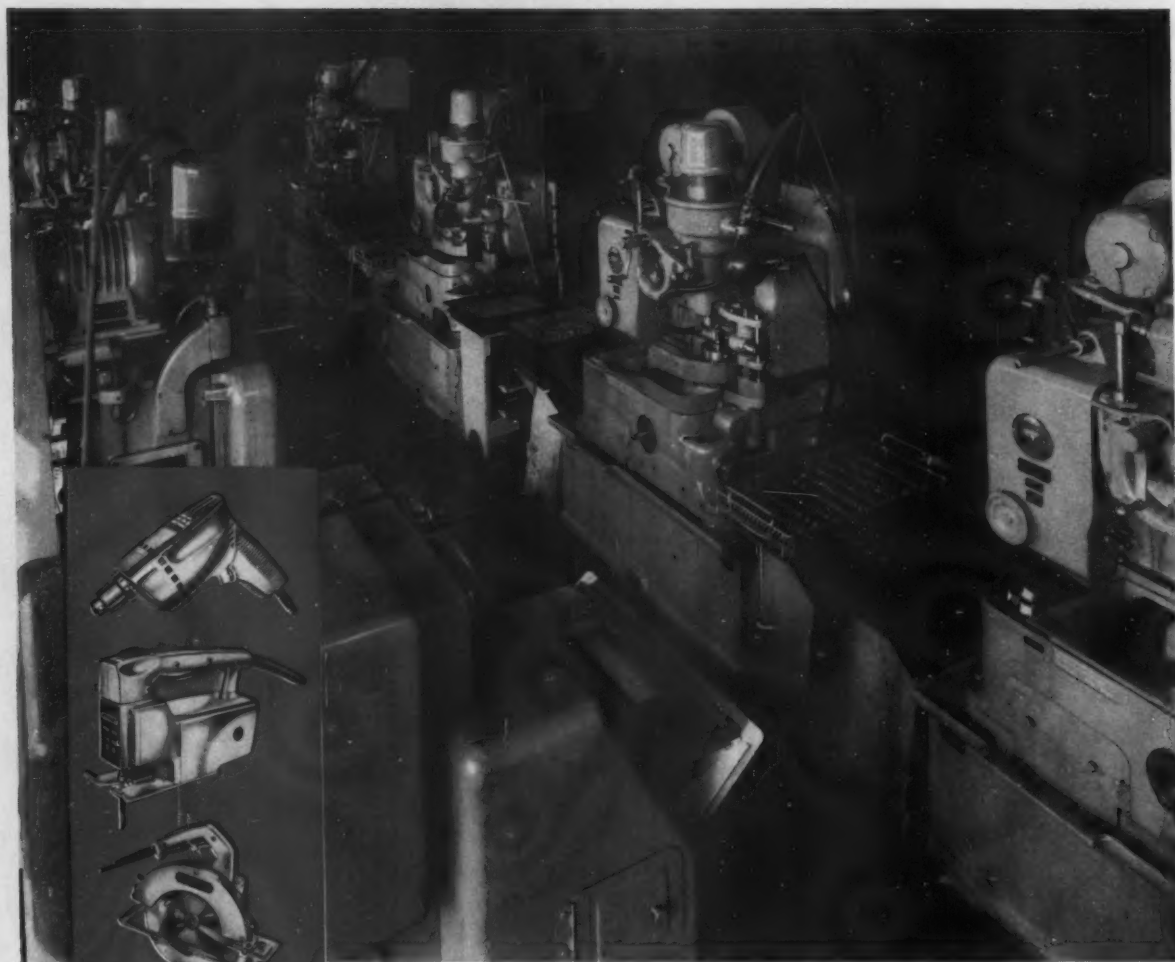


Thread Rolling Tools



FELLOWS GEAR PRODUCTION

Builds Extra Quality



View of production floor at Stanley Electric Tools, showing some of the Fellows Gear Production Equipment used.

Gears produced with Fellows Machines add high quality to these Stanley Electric Tools.

THE
PRECISION
LINE

Fellows

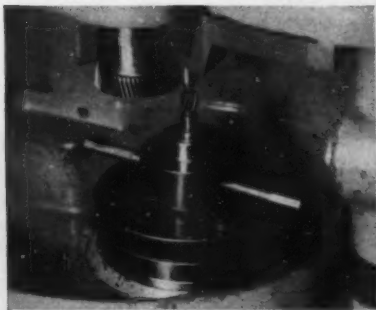
EQUIPMENT at Lower Cost for STANLEY

Stanley is a name you know . . . a name that stands for high quality in electric tools.

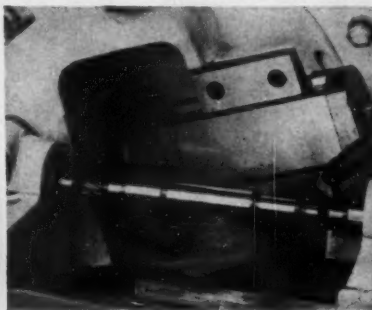
To insure this quality, while providing the high production rates that mean lower costs, Stanley Electric Tools, Division of The Stanley Works at New Britain, Conn., uses Fellows Gear Production Equipment for shaping, shaving and inspecting the armature pinions for its electric tools.

Fellows has long been the leader in Gear Production Equipment, with machines for every gear production job: Fellows Gear Shapers, Pfauter Gear Hobbers, Fellows-Reishauer Gear Grinding Machines, Fellows Gear Shaving Machines and Fellows Inspection Instruments.

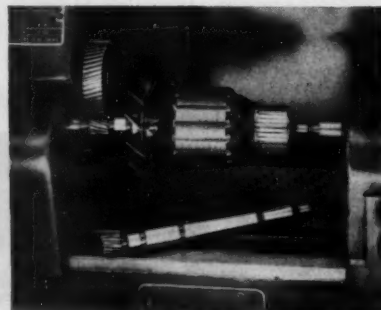
If you make gears of any size, from 1/16" P.D. to 120" P.D., Fellows' 60 years of experience can help you improve quality and cut costs. For complete information on Fellows Gear Production Equipment, call your nearest Fellows office.



SHAPING. The versatile No. 7125 Fellows Gear Shaper gives Stanley high production speeds (up to 450 strokes per minute). It also provides fast, simple changeover from one job to another.



SHAVING. The No. 4 Fellows Fine Pitch Shaving Machine puts finishing touches on each pinion and adds the finish which results in long life and quiet operation.



INSPECTING. The No. 4 Fellows Fine Pitch Red Liner makes and records a composite check of gear accuracy, insuring high quality standards.

Gear Production Equipment

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont

Branch Offices:

319 Fisher Building, Detroit 2
150 West Pleasant Avenue, Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Avenue, Los Angeles 45

New CINCINNATI 210-6 *Centuramic*

**makes it easier than ever before
to Centerless Grind Small Quantities**

Centuramic is a new name in low-cost, precision centerless grinding. Centuramic, a product of Cincinnati's Grinding Machine Division, extends the advantages of centerless grinding to more shops than ever before.

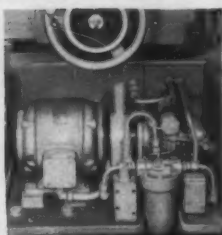
These new machines are convenient to operate and set up because of wider throat opening between the wheels . . . unobstructed floor space wherever the operator needs to stand . . . toe space at the floor line . . . infinitely variable regulating wheel speeds . . . center mounted chain drive for the regulating

wheel spindle, arranged to promote the highest quality finish on the work . . . built-in mist control unit*. rear infeed controls.*

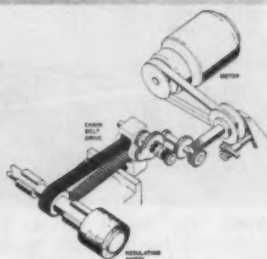
And maintenance is minimized to the vanishing point. Hydraulic unit, for example, is mounted outside where it's accessible . . . no twist, no bind on the regulating wheel spindle drive chain . . . FILMATIC grinding wheel spindle bearings never wear out or require adjustment. Many more feature-advantages are outlined in a new catalog, No. G-728. Write for a copy today.

**Extra cost equipment*

Centuramic FEATURES



Low maintenance costs have been achieved in several ways . . . outside mounted hydraulic unit, for example.



Quicker setup is attained through infinitely variable regulating wheel speeds. Self-contained chain drive assures exceptionally smooth work rotation.



Cleaner working area for the operator. The cutting fluid mist control unit (extra) effectively exhausts bothersome mist.

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

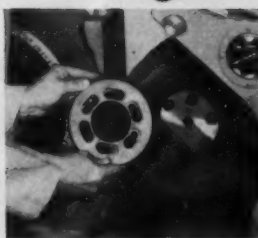
CINCINNATI

FILMATIC

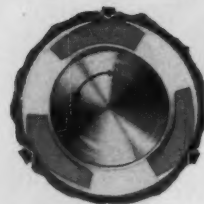
New CINCINNATI 210-6 Centuramic Centerless Grinding Machine, the "Handy Andy" of the Centuramic line. Cost-reducing extra equipment: Vari-Pitch In-feed Attachment, micrometer handwheel, profile regulating wheel truing.



Rear controls make the 210-6 Centuramic more convenient to operate and set up.



Convenience and quicker setup are evident here. Simply loosen six screws, slip off the flange with a slight turn, and the regulating wheel is free to be removed.



Zero maintenance of grinding wheel spindle bearings has long been a CINCINNATI FILMATIC advantage. Centuramic, of course, incorporates this cost-reducing bearing.

• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®

GRINDING MACHINE DIVISION

Save on first cost: One compact grinder multi-purpose versatility

Landis 12" x 28" Universal and Tool Grinder
22 optional accessories extend range
of grinding operations



LANDIS

precision grinders

LANDIS TOOL COMPANY

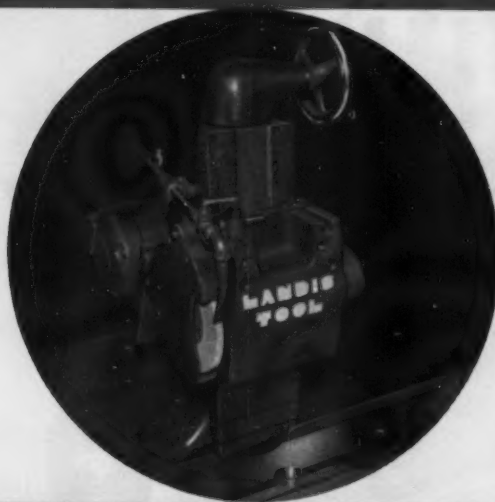
WAYNESBORO, PENNSYLVANIA

for toolroom precision and

features that assure fast setups, precision results



Continuously variable speed headstock drive permits adjustment for the best work speed without shifting belts. Only two revolving parts.

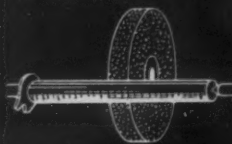


Rigid wheel head mounting on massive column adds stability for accuracy and fine finishes. Vertical ways for wheel height movement protected by telescoping covers below wheel head.

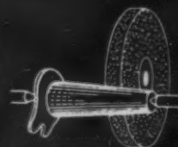


Tool sharpening . . . a wide variety of tools and cutters can be sharpened with standard and extra equipment.

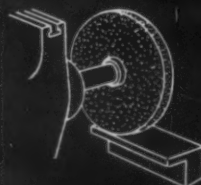
grinding operations with standard equipment



cylindrical



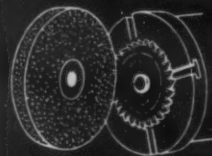
taper



surface



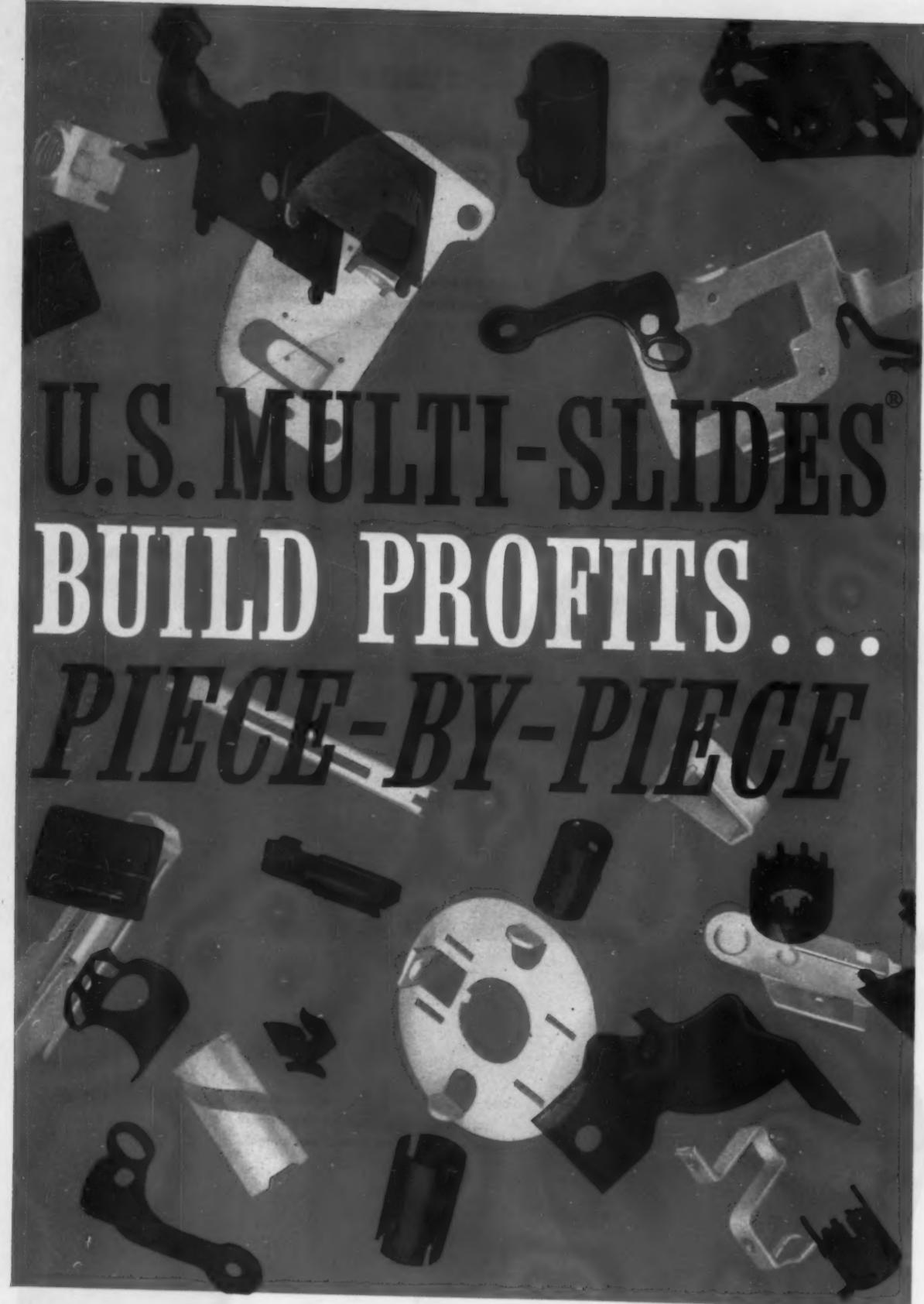
tooth sharpening



face



spiral mill

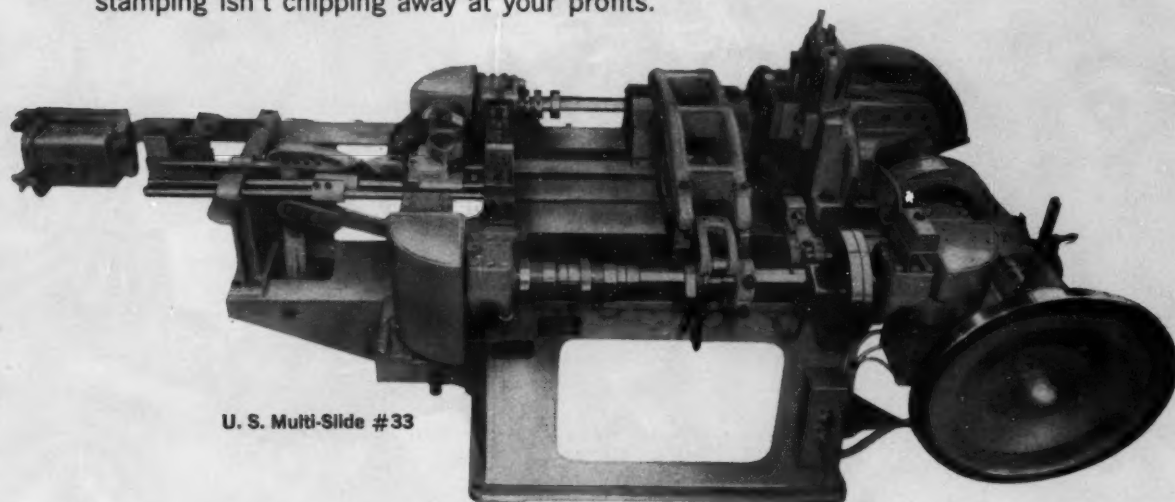


U.S. MULTI-SLIDES®
BUILD PROFITS...
PIECE-BY-PIECE

Hour after hour, day after day, U. S. Multi-Slides are producing perfect pieces like these — by the hundreds of thousands. A single cycle of the machine produces a FINISHED formed stamping. Secondary operations and expensive handlings are eliminated.

Multi-Slide production is consistently accurate even on complicated shapes and assemblies. Minimum inspection rejects result in higher output rates.

Unless you are now using U. S. Multi-Slides, you can't be sure your present method of stamping isn't chipping away at your profits.



U. S. Multi-Slide #33

To be certain, send us samples and "specs" of the stampings you are now making, or submit specifications of projects you are considering. Let us give you the facts of "piece-by-piece" profit through advanced U. S. Multi-Slide methods . . . you will be under no obligation.

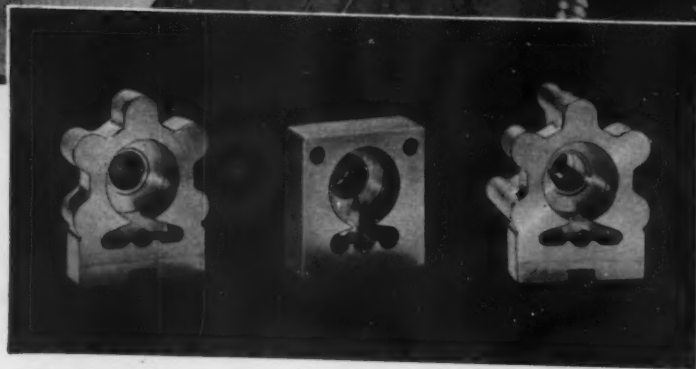
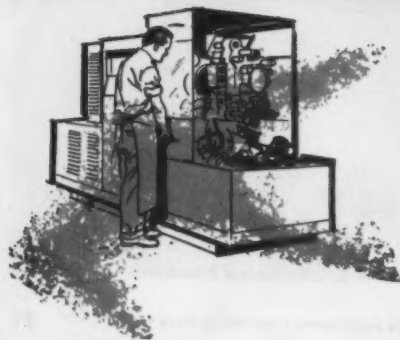
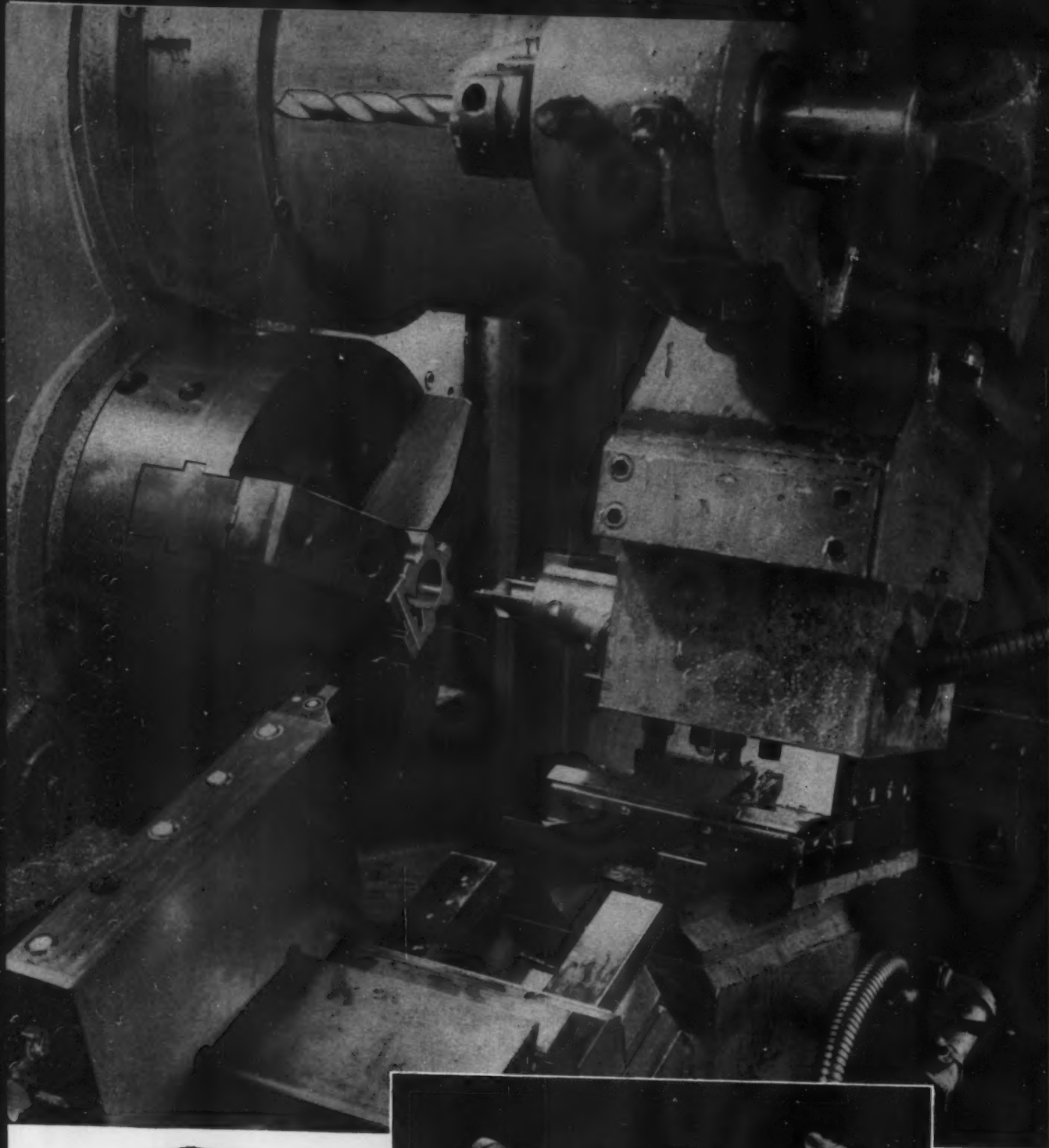
Write today for Bulletin 15-M.



U. S. TOOL COMPANY, INC.

AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories



At Eco Engineering Company

NEWARK, NEW JERSEY

Pump parts with Missile grade accuracy now produced on production basis

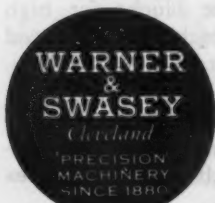
As a result of Eco's installation of two Warner & Swasey 2AC Chucking Automatics, the chemical process industry has, for the first time, a wide selection of standard stock pumps at production prices. Formerly, high-cost custom-built units were always used.

Moving highly corrosive and/or hazardous liquids is routine for Eco's small rotary displacement and centrifugal pumps. For example, the successful Vanguard II Rocket was fueled at Cape Canaveral with an Eco pumping unit.

To meet these extreme safety and accuracy requirements demands precision machining of nickel alloy materials and austenitic stainless steels—both extremely difficult to machine because of their work-hardening characteristics. Their Warner & Swaseys offer definite advantages by providing extreme rigidity and constant tool feed pressures.

Because pump capacity and volume, as well as long life and freedom from vibration, are dependent on good fits, components are machined on the Warner & Swaseys to tolerances as low as .0005". Formerly Eco had to rough out pump bodies on turret lathes—then finish to the necessary close tolerances on specialized precision finishing equipment. Now all operations are handled easily on the 2ACs—and at production rates from 3 to 10 times faster than previous methods.

Our Field Engineers have the complete facts on how these versatile Automatic Chuckers can boost your production and profits on precision work. Why not call him in, today.

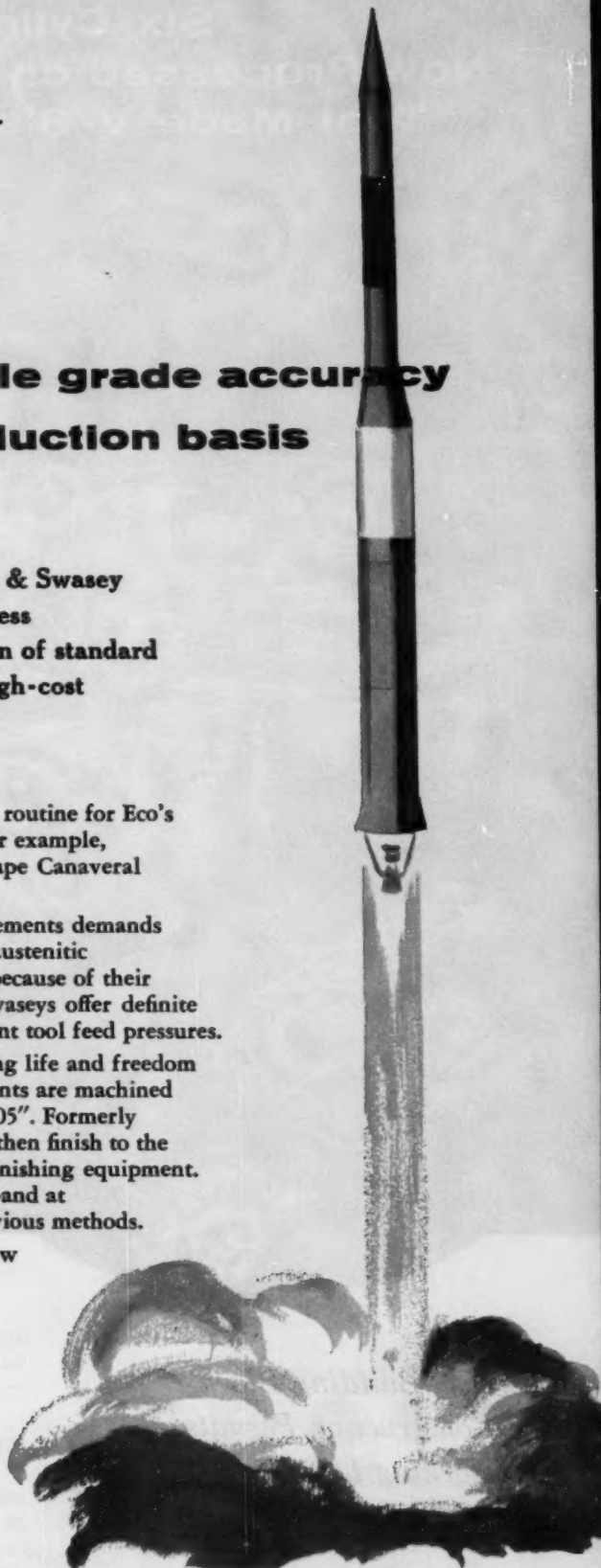


YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

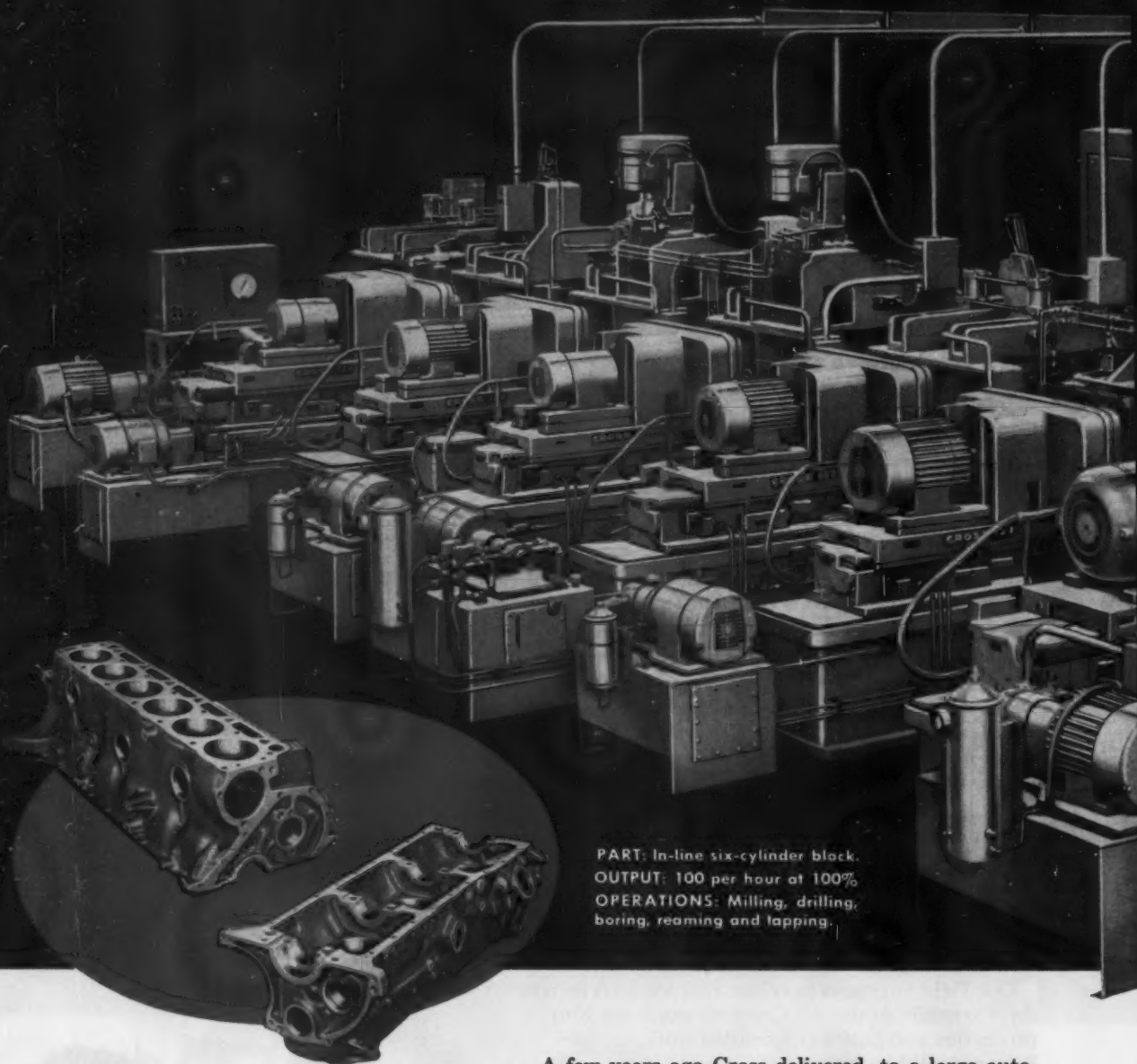
MACHINERY, January, 1960

For more data circle this page number on card at back of book

13



Six-Cylinder Engines Now Processed on Cross Transfer-matics That Made V-8's a Few Months Ago



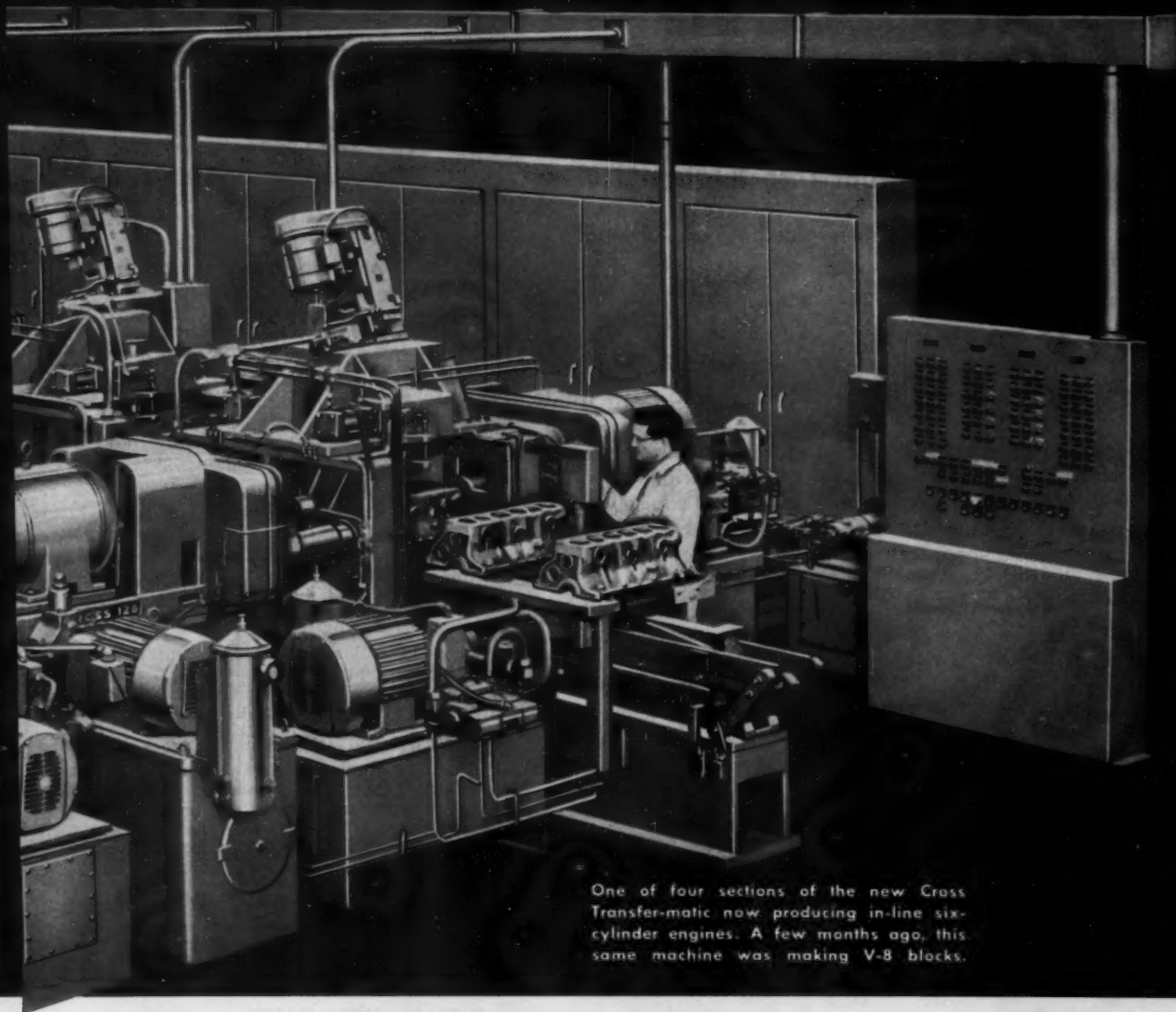
PART: In-line six-cylinder block.
OUTPUT: 100 per hour at 100%
OPERATIONS: Milling, drilling,
boring, reaming and tapping.

*Cross "Building Block"
Construction Permits
Reworking Line at 40%
of Original Cost*

A few years ago Cross delivered, to a large automobile manufacturer, three Sectionized Transfer-matics for machining cylinder blocks for high powered V-8 engines. These machines introduced new concepts of flexibility by standardizing bases, transfer mechanisms, fixtures, heads and other component parts.

Last year, due to public demand, the car company had to make a quick switch from V-8 engines

Another Transfer-matic by Cross



One of four sections of the new Cross Transfer-matic now producing in-line six-cylinder engines. A few months ago, this same machine was making V-8 blocks.

to small in-line sixes. The new standards that Cross created for these Transfer-matics permitted the change to be made in a minimum amount of lead time and at a cost savings of 60%.

Today, one line is already producing in-line six-cylinder engine blocks and a second line is being converted for a production increase during 1960. This is proof positive that Cross engineered flexibility does pay off and that it costs no more.

Established 1898

THE **CROSS** CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

YOUR HEADQUARTERS for PRECISION



offers a complete line for every use
...all available from ONE local source

No matter what your needs for accurate dimensional control in measuring

- lengths
- heights
- widths
- angles
- diameters
- flatness
- parallelism
- finish

DoALL has the instruments and equipment to help you solve your problems quickly and economically. And DoALL has the long experience necessary to advise you as to proper procedures, methods, results. This service by factory-trained specialists is free.

DoALL precision measuring and inspection equipment is carried in stock—ready for immediate delivery—in your nearby DoALL Store. Here's one reliable source... one responsibility... for more than 1500 top-quality products. This large local inventory is backed by a \$2,000,000 central warehouse stock—connected to each DoALL Store by Teletype for prompt service.

DoALL EDUCATIONAL AIDS

In addition to the free services of its dimensional quality control specialists, your nearby DoALL Store offers many educational aids. These aids include: "Height Combination Tables," "Heat Expansion Calculator," "The Facts of Gage Block Life," "Fringe Line Pattern Wall Chart" and others. Ask your DoALL specialist for copies.

COMPLETE CALIBRATION SERVICE

DoALL gage block users and owners of other gage blocks can have their blocks recalibrated by DoALL's laboratory technicians. Inspection and calibration services are also available for thread, cylindrical, plug and ring gages.

G8-32



THIS IS A
TYPICAL DoALL STORE



1 GAGE BLOCKS AND ACCESSORIES

Accuracy begins with fine gage blocks. Get the best. DoALL gage blocks offer the utmost in accuracy—with tolerances that meet or exceed N.B.S. requirements. What's more, you get the finest finish in the industry, patented "Burr Proofing," special processing to guarantee stability. DoALL offers a complete line—21 sets, 5 to 121 pieces—in rectangular and square styles. AA, A+ and A grades.

NEW! 56-PIECE SET. A new, practical set for shop use gives more useful dimensions with fewer blocks... saves time in setups, inspection.

MICRO-STEP GAGES. Quickly assembled with rectangular blocks and special holders. Result: an unlimited number of different, accurate gages for inside and outside measurement.

2 LAYOUT AND INSPECTION EQUIPMENT

DoALL black granite products go far beyond usual tolerances—beyond federal specifications. Manufactured to *Unilateral Tolerance Limits*. DoALL now delivers *twice* the accuracy for the same money or less.

DoALL black granite surface plates are made in 432 sizes, ledges, accuracies. Also available: angle plates, straightedges, parallels, master flats, magnetic chuck platforms, plate stands... and a complete line of metal plates, straightedges, accessories.

3 COMPARATIVE MEASUREMENT

DoALL offers a complete line of the finest electronic, mechanical and optical comparators—answering every need in laboratory, toolroom, shop and inspection departments. DoALL electronic comparators measure in millionths!

4 SHOP INSPECTION GAGES

At your local DoALL Store—complete lines of micrometers; calipers; thickness gages; dial indicators; snap gages; thread ring, cylindrical plug gages; many other types. Highest quality always.

5 OPTICAL INSTRUMENTS

All DoALL Stores feature the complete line of Bausch & Lomb Stereo-Zoom microscopes, toolmaker's microscopes, readers, magnifiers. And for utmost precision in optical production measurement control—the B & L Contour Measuring Projector.

6 LIGHT WAVE MEASUREMENT

DoALL monochromatic lights, using a helium light source, and optical flats are necessary for inspection by interferometry. "Monolights" are portable, made in two sizes. DoALL optical flats of pure, fused Brazilian quartz—made in round and square styles.

7 SURFACE FINISH GAGES

Surface roughness scales and specimens aid in specifying and inspecting both flat and cylindrical surfaces. Flat scales show 13 representative surfaces. Cylindrical scales—available in internal-external and turned-bored styles. Specimen sets show 25 types of surfaces on ten blocks.

8 ANGLE MEASUREMENT

DoALL sine bars and plates are produced to laboratory grade standards—within N.B.S. tolerances. Sine bars are 5 in. long. Sine plates—available in 5- and 10-in. sizes. Universal bevel protractors offer highest quality. Range: 0-90° through 360°.

THE  COMPANY

MEASURING and INSPECTION EQUIPMENT

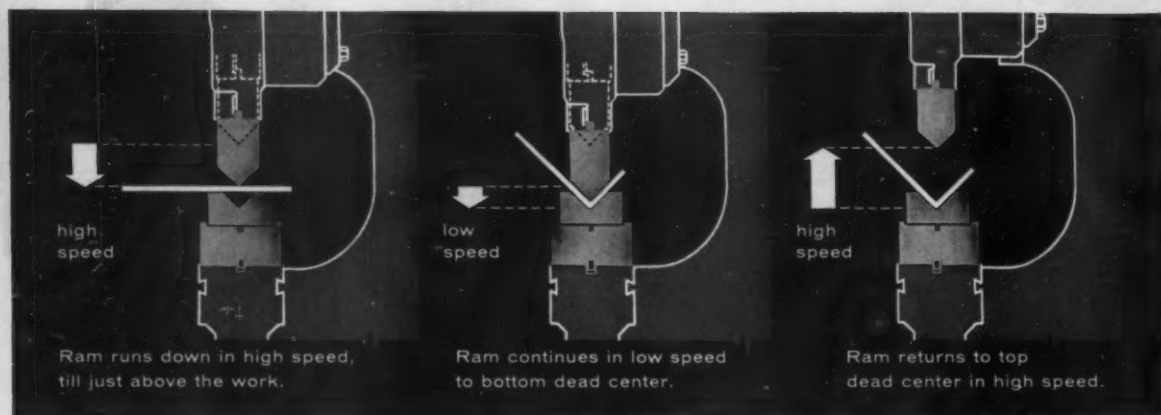


DES PLAINES, ILLINOIS



INCREASE PRODUCTION AS MUCH AS 60% WITH CINCINNATI®

Automatic Cycle Press Brakes



If you form long, flexible parts, you can increase your production up to 60% with a Cincinnati Automatic Cycle Press Brake.

A new, exclusive feature, the Cincinnati Automatic Cycle provides a combination of instantaneous fast and slow ram speeds with every stroke. As a result, you get maximum production speed without the "whip up" and "back bending" which often occur in high speed forming of long parts which have no beam strength.

You no longer have to rely on the operator's skill at clutch slipping to obtain parts that are free of "back bends."

You can get this money-making feature on all new 7 and 9 Series Cincinnati Press Brakes.

This productive new feature means a lot of advantages for you:

1. Job records show 10% to 60% increase in parts formed per hour.
2. Low speed portion of the ram stroke can be set so that all strokes are identical in length.
3. Rejects caused by "back bends" are stopped.
4. Highly experienced operators are not required.
5. Operator fatigue is greatly reduced because there is no need for clutch slipping.
6. Clutch and brake are long-life, minimum-maintenance units requiring no adjustments.

Write Dept. D for full details about the Cincinnati Automatic Cycle, Bulletin B-9R.

Shapers / Shears / Press Brakes

THE CINCINNATI
SHAPER co.



Cincinnati 11, Ohio, U.S.A.

versatility:

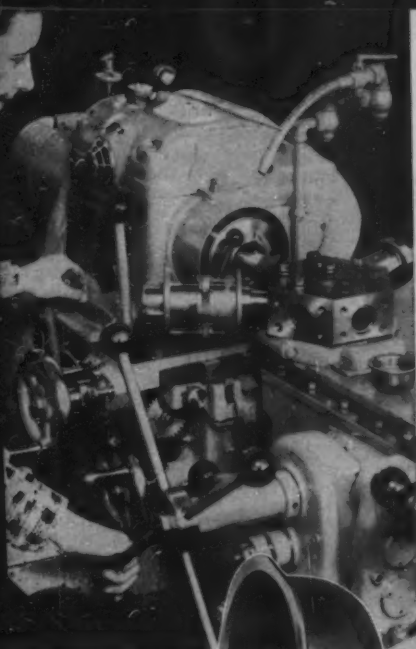
precision grind **TWO** parallel surfaces of
widely varying parts in **ONE** operation



*Gardner 2H30
precision double spindle grinder*

Send prints of your parts for a Gardner
proposal and request new general catalog.

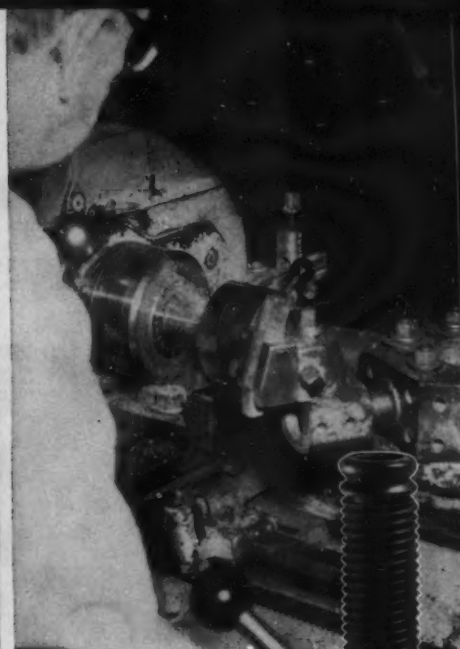
GARDNER
precision disc grinders
BELOIT, WISCONSIN



Two pieces per minute is the production rate for these Steel Control Housing Caps. They have a 2¼-16 N-3 thread tapped at 80 RPM.



Aluminum Valve Bodies are machined at 610 RPM—500 SFPM. Special tooling enables machining of five surfaces in only one operation — at tolerances of $\pm .001$ -inch!



Vulcanized Fiber parts are turned at up to 2000 SFPM in lot sizes from 10 to 10,000 pieces. Part shown is being threaded — 1¼-7 NC-2 thread — at 810 RPM.



Here's Real Turret Lathe Flexibility...

No. 2 Bardons & Oliver handles steel, aluminum and vulcanized fiber jobs efficiently, economically

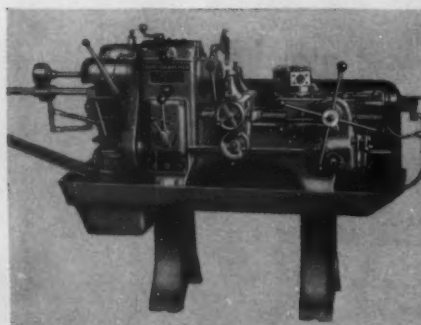
Photos above show the wide variety of materials being machined today on Bardons & Oliver No. 2 Geared Electric Turret Lathes. With these versatile production-boosting machines you can handle either bar or chucking jobs—up to 3500 RPM!

Check these exclusive features—offered on the B & O No. 2—that enable progressive shops to increase production, cut costs.

- **SINGLE LEVER SPINDLE CONTROL WITH DIRECT READING SPEED DIAL** for six geared speed changes.
- **SINGLE LEVER ELECTRIC STOP-START-REVERSE** with capacity to 10 cycles per minute.
- **SINGLE LEVER ELECTRIC HIGH-LOW SPEED CHANGE** with instantaneous, effortless response to the operator's touch.
- **SINGLE LEVER CONTROL WITH DIRECT READING FEED DIAL** for six feed changes.
- **DIRECT FLANGE-MOUNTED HIGH TORQUE MOTOR WITH INTEGRAL DYNAMIC BRAKE.** No belts, pulleys, or belt idler.
- **RIGIDITY AND STRENGTH WITHOUT EXCESS WEIGHT** to increase productive capacity while decreasing operator fatigue.

Since Bardons & Oliver produce a complete line of advance-designed turret lathes, our engineers can recommend the *correct* machines to handle your most varied and exacting jobs. Check with your Bardons & Oliver representative and be shown how these rugged lathes can help increase your overall profit picture.

**Bardons & Oliver, Inc., 1133 West 9th Street
Cleveland 13, Ohio**



MACHINE SPECIFICATIONS

- 1" or 1¼" Bar Capacity
- 13½" Swing Over Bed
- 6½" Swing Over Cross Slide
- All Geared Headstock
- Spindle speeds up to 3500 RPM

BARDONS & OLIVER

Write for your copy of Illustrated Brochure on the Bardons & Oliver No. 2 Geared Electric Turret Lathe.



Manufacturers of a Complete Line of Turret Lathes and Cutting-Off Lathes

A NEW CUSTOMER-ORIENTED U.S. SOURCE FOR NATURAL DIAMONDS

Six announcements of major importance to
users and manufacturers of abrasive products

NOW—a new customer-oriented

1. A new, major U.S. supplier

Engelhard Industries, Inc. announces the establishment of its Industrial Diamond Division—dedicated to the single objective of providing a full complement of technical sales services to purchasers and users of natural industrial diamonds. In addition to technical aids, extensive U. S. inventories, research capability and purchasing assistance, Field Representatives offer their technical services from offices in Boston, Chicago, Cleveland, Detroit, Los Angeles, Newark, New York City and Philadelphia.



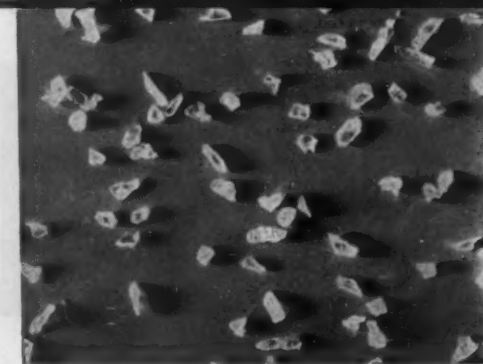
2. In-plant technical assistance

This new customer-oriented business is fully prepared to assist you with your abrasives problems. From their locations in key metalworking centers, the Industrial Diamond Division's Field Engineers with their training and experience in *your* kind of tool room and production work are readily available. This "industrial diamond task force" gives in-plant assistance whenever, wherever needed.



3. A new grit for increased wheel life

Performance in the range of 30% longer life for natural diamond resinoid-bonded grinding wheels is made possible by new "SND" (Selected Natural Diamonds) grit. This dramatic development permits constant exposure of only the optimum cutting surfaces in the wheel, and prevents the grit from being prematurely forced out of the bond. Ask your grinding wheel representative about SND-Resinoid natural diamond wheels, or write direct to Engelhard Industries for complete information.



ABOUT ENGELHARD INDUSTRIES...

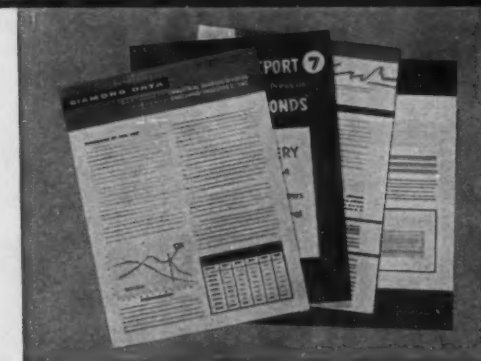
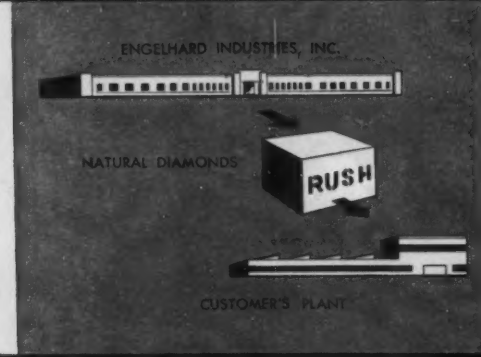
Started in 1889, Engelhard Industries, Inc. is a major American industrial complex serving the world from home offices in Newark, N. J.

Although it is perhaps best recognized in the precious metals field, the Engelhard group produces diverse products for virtually all industries, including metal products manufacturing, iron and steel, aircraft and missiles, electronics, nucleonics, chemical and petroleum production.

Engelhard Industries' technical interest in the uses of industrial diamonds has developed from its own production testing and engineering investigation to its present widespread activity at the basic research and application levels.

Today, through its new Industrial Diamond Division, Engelhard Industries has combined its experience and facilities in the field of natural diamonds to supply and service the specific requirements of U. S. industry.

U.S. source for natural diamonds



4. 'Diamond Tech Lab'

Experienced metallurgical engineers, tooling and abrasive experts and other specialists staff the newly-formed Diamond Technology Laboratory—a customer service facility in Newark, N. J. Created to solve technical problems in the application of industrial diamonds, the "Diamond Tech Lab" is cooperating with diamond wheel and tool manufacturers, as well as with the end-user of industrial diamond products.

5. 'Off-the-shelf' availability

Engelhard Industries stocks natural diamonds in a complete range of sizes and shapes, in quantities to continually satisfy the needs of American industry. These stocks include fragmented boart, grit (standard, SND-treated or untreated) and larger industrial stones for setting and drilling applications. These stocks will greatly reduce inventory investments, cut delivery cycles and expedite the purchase of industrial diamonds.

6. Technical information service

The Industrial Diamond Division provides a new and complete technical information service to help keep you abreast of the latest developments in diamond products and applications. These new Technical Bulletins will be sent to you without obligation. Simply send us your name, title and company address and we will place your name on our Diamond Technical Bulletin mailing list.

ENGELHARD

INDUSTRIES, INC.

INDUSTRIAL DIAMOND DIV.

113 ASTOR STREET • NEWARK 2, N. J.

DOMESTIC DIVISIONS: AMERICAN PLATINUM & SILVER DIVISION • AMERSIL QUARTZ DIVISION • BAKER CONTACT DIVISION • BAKER DENTAL DIVISION • BAKER SETTING DIVISION • BAKER PLATINUM DIVISION • CHEMICAL DIVISION • EAST NEWARK INDUSTRIAL CENTER • HANOVIA LAMP DIVISION • HANOVIA LIQUID GOLD DIVISION • INDUSTRIAL DIAMOND DIVISION • INSTRUMENTS AND SYSTEMS DIVISION • IRVINGTON-BAKER REFINING DIVISION • D. E. MAKEPEACE DIVISION • NATIONAL ELECTRIC INSTRUMENT DIVISION • RESEARCH AND DEVELOPMENT DIVISION • H. A. WILSON DIVISION.

COMPANIES ABROAD: ENGELHARD INDUSTRIES OF CANADA, LTD. TORONTO • ENGELHARD INDUSTRIES OF QUEBEC, LTD. MONTREAL • ENGELHARD INDUSTRIES, LTD. LONDON • ENGELHARD INDUSTRIES A. G. ZURICH • ENGELHARD INDUSTRIES PTY., LTD. VICTORIA • SOCIEDAD SURAMERICANA DE METALES PRECIOSOS S. A. BOGOTA • INDUSTRIE ENGELHARD S. P. A. ROME • ENGELHARD INDUSTRIES OF SOUTHERN AFRICA, LTD. JOHANNESBURG. **ASSOCIATED COMPANIES:** ACME TIMBER INDUSTRIES LTD. • SOUTH AFRICAN FOREST INVESTMENTS LTD., SOUTH AFRICA • AZOPLATE CORPORATION • NUCLEAR CORP. OF AMERICA, U. S. A. 60-A

GRAY *giant*

The new GRAY Horizontal Boring, Drilling, and Milling Machine is a giant for power, yet so precise it works to minute tolerances.

You'll find a rapidly increasing number of these cost-cutting giants in modern shops throughout the world.

GRAY'S high precision, ease of operation, and modern power will do your jobs better and faster, further proof that

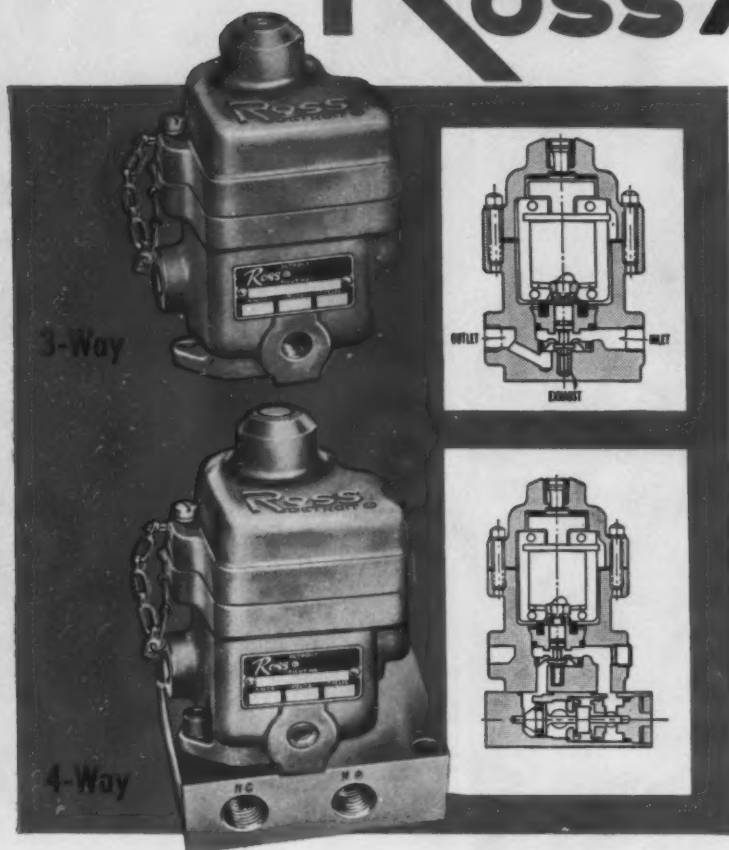
Quality doesn't cost . . . it pays.

The G. A. GRAY CO., Cincinnati, Ohio



Announcing a new and better solenoid valve in the $\frac{1}{8}$ " and $\frac{1}{4}$ " size range

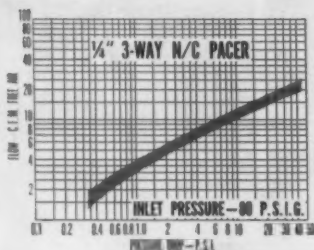
ROSS PACER



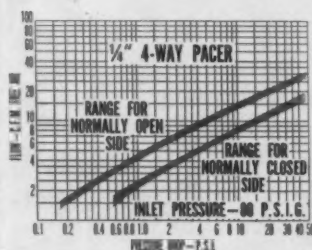
More life
More speed
More capacity
More value

Now you can have about three times more flow capacity-to-solenoid size than in most competitive valves. Needs just 7 watts of power yet minimum internal orifice size is full $\frac{1}{8}$ ". The PACER has short poppet travel, will cycle at better than 1000 cpm and meets JIC specifications. Lightweight, cast aluminum body means 3-way weighs just 20 ounces, 4-way just 28. Dust tight, liquid tight, can be manually actuated, has captive cover, is inoperative with cover removed, has integral wiring space. Why not test a PACER in your own circuit, just \$18 for a 3-way, \$26 for a PACER 4-way. Call your Ross representative or write for Bulletin 319.

Pressure drop thru 3-way N.C. Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shown as a range rather than as absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.

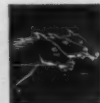


Pressure drop thru both N.C. & N.O. sides of 4-way Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shows ranges for each side rather than absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



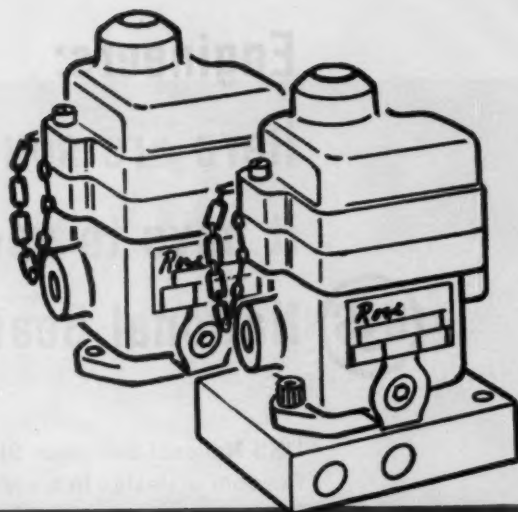
ROSS OPERATING VALVE COMPANY

110 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.



The **Ross** PACER gives you 56 new solenoid air valves

The Ross PACER is a fine new solenoid valve in the $\frac{1}{8}$ " and $\frac{1}{4}$ " size range that gives a full $\frac{1}{2}$ " flow capacity yet uses only 7 watts of holding power. The PACER is built for especially long life yet is priced surprisingly low. Capable of 1000 cycles per minute and more, is JIC, and very light and compact. And if you're interested in large valves the PACER has a second identity, that of a pilot section to actuate any valve of the Ross Skyline series. It will operate any of these valves at top speed and with low power consumption.



As well as being a complete new valve

...PACER is also a new pilot section in the Ross Skyline valve series...

COMPLETE PACER VALVES

STRAIGHTWAY, N/C
3-WAY, N/C
4-WAY

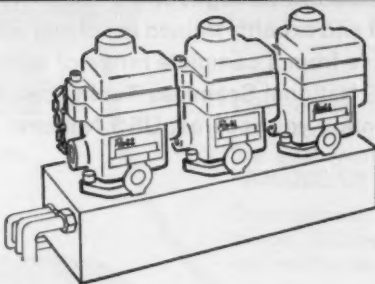
PIPE SIZES						
$\frac{1}{8}$ "	$\frac{1}{4}$ "	$\frac{3}{8}$ "	$\frac{1}{2}$ "	$\frac{3}{4}$ "	1"	1 $\frac{1}{4}$ "
✓	✓					
✓	✓					
✓	✓					

SKYLINE VALVES USING PACER AS ACTUATOR (HEAD)

STRAIGHTWAY, N/C
STRAIGHTWAY, N/O
3-WAY, N/C INLINE MT.
3-WAY N/O, INLINE MT.
3-WAY, N/C, BASE MT.
3-WAY, N/O, BASE MT.,
4-WAY, INLINE MT.
4-WAY, BASE MT.
4-WAY, 5-PORT

	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓
	✓	✓	✓	✓	✓	✓

New PACER manifolds to save piping and wiring



Ross manifolds provide a compact and economical method of multiple mounting PACER valves. One air supply line and one electrical conduit can serve all PACER valves. Manifolds are available in two and three stations.

ROSS OPERATING VALVE COMPANY

110 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.



Engineers:
Here are sound reasons why
it pays to specify

National Seamless Mechanical Tubing

USS National Seamless Steel Mechanical Tubing offers you extraordinary freedom of design in a wide range of products from bushings to hydraulically operated telescoping booms. And, USS National Seamless Tubing helps cut processing costs, because it eliminates drilling operations; enables you to replace drills with simple, less expensive boring tools, and it reduces tool wear and tool changes; and, more important, more uniform parts can be turned out by the hundreds or thousands.

Where USS National Seamless Tubing is used as a load-carrying member or part, it exhibits a number of structural advantages over other forms. *Here are a few:* it gives you a superior cross section when a part is designed to withstand equal loading in any direction; it resists bending stresses equally in all directions; it is able to absorb and localize shock; and in torsion, it provides better material distribution, and for a given weight, can withstand more load than other sections.

And, of course, the name USS National is backed by the world's largest and most experienced manufacturer of seamless tubing—National Tube! The production of USS National Seamless Tubing, from ore to finished product, is entirely controlled by one organization. There is no divided responsibility. Every foot, every length, is made under the careful supervision of skilled men with years of tubemaking experience. For more than 60 years, USS National Seamless Tubing has been first with men who want the best in mechanical tubing.

You'll find USS National Seamless Tubing available at select National Tube Distributors throughout the country. These distributors are strategically located and expertly trained in solving all types of tubing problems. Here, you can choose from a complete range of sizes and stocks. If you'd like to find out how USS National Seamless Tubing can be most effectively applied to your designs, contact your nearest USS National Distributor . . . soon!

USS and National are registered trademarks

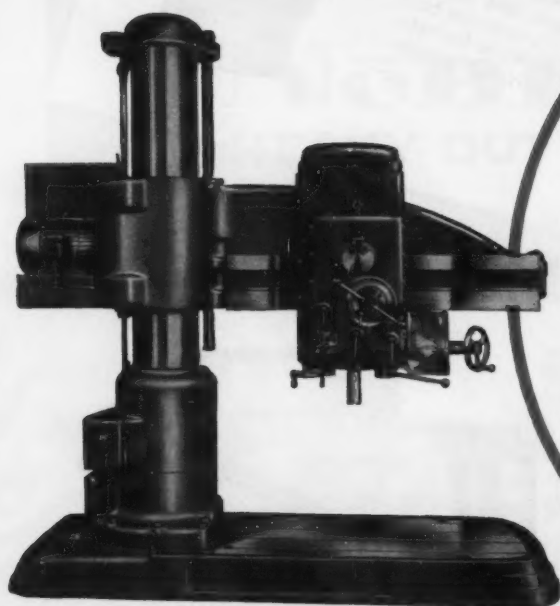
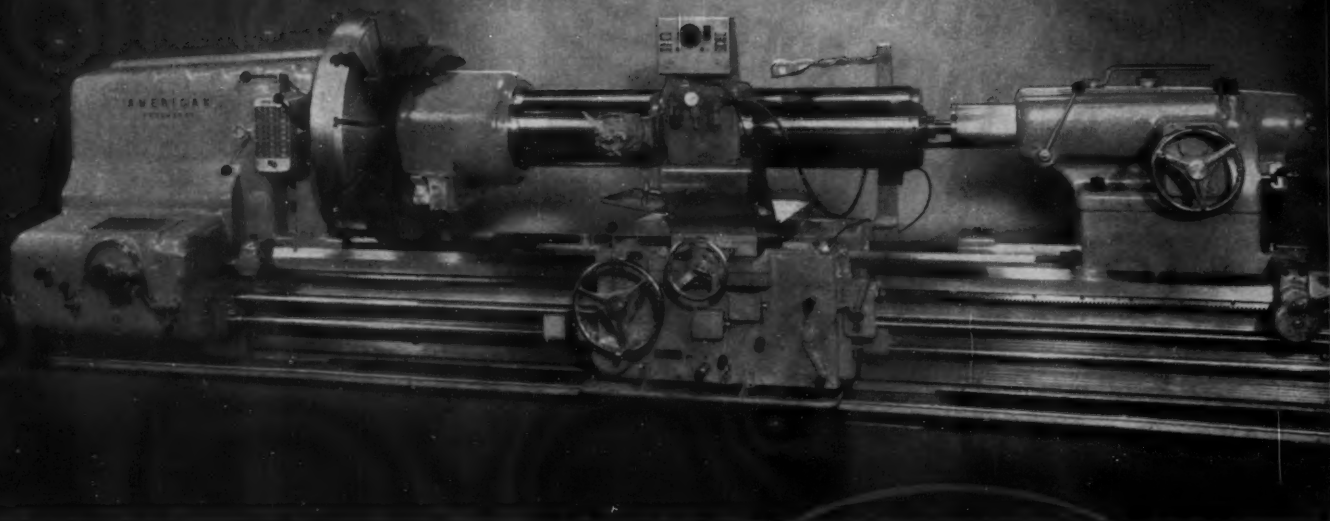


**National Tube
Division of
United States Steel**

Columbia-Genesee Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Supply Division
United States Steel Export Company, New York

MIRROR FINISH

... that Reflects not only
LIGHT ... but
QUALITY



All "AMERICAN" Hole Wizard Radial Drill Column Sleeves are now super-finished to a beautiful "mirror" finish.

Not only does this vastly improve the appearance of the machine but which is far more important it minimizes the danger of column cutting and scratching.

This operation is done in our own plant on a brand new 40" "AMERICAN" Pacemaker Lathe equipped with a new No. 4 Gisholt Super-finishing attachment.

This represents just another step along the path of continuous modernization to improve the quality and also the inherent value of "AMERICAN" Lathes and Radial Drills.

Descriptive bulletin No. 328 will be of interest to you. It illustrates and describes many new and exclusive features.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

GOOD NEWS FOR COST MINDED TOOL ENGINEERS STANDARDIZED UNIVERSAL INDEX PLUNGERS COST 75% LESS THAN SPECIALLY-MADE TOOL ROOM PLUNGERS



In jig or fixture manufacture, it's both expensive and time-consuming to design and machine special index plungers for multi-station tools. To save time and money use Universal Straight or Taper Plungers. They are made in standard sizes . . . come complete, ready for installation . . . at approximately $\frac{1}{4}$ the cost of specially made tool room plungers. Universal Index Plungers can be assembled from either top or bottom and can be removed in either direction. Because the Universal plunger body and bushing have the same standard diameter . . . all holes can be bored with the same tool, simplifying drilling of jig or fixture in fabrication.

Universal Index Plungers can be actuated by either hand lever or air cylinders for automatic indexing tools. The locating bushing, plunger and plunger bushing are hardened and ground . . . precision built for extreme accuracy and long wear. Write for catalog detailing plungers plus other Universal production tools.



OTHER PRECISION-BUILT COST-SAVING UNIVERSAL PRODUCTION TOOLS



Floating Chuck



Standard Collet Chuck



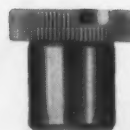
Mikro-Lok Boring Bar



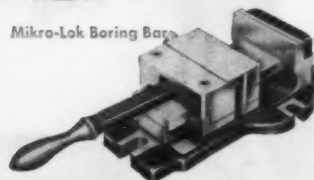
Boring Chuck



"Kwik-Switch"
Tool Holder



Standard Drill Bushing



Wedge-Lock
Production Vise

UNIVERSAL ENGINEERING COMPANY, FRANKENMUTH 2, MICHIGAN

NEW

NEBEL

HEAVY DUTY ENGINE LATHE

entirely new, proven design

proven design features . . .

Here is the second in the entirely new, field-tested line of heavy duty Nebel Lathes, extending Nebel economies even further into the heavy duty field.

The rugged, proven design Nebel Model 2516 Engine Lathe is built to the complete A.S.A. standards and tolerances of accuracy for engine lathes. It offers you more accuracy, more power, more and higher spindle speeds than ever before available from Nebel.

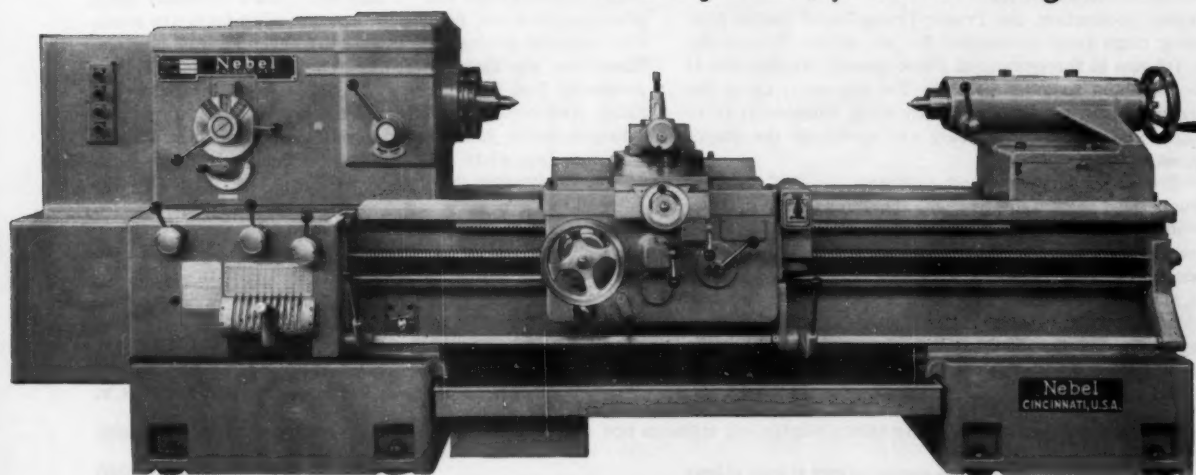
- Heavy duty 3-bearing spindle with zero precision bearings.
- 18 spindle speeds through complete gear range . . . up to 1500 RPM . . . streamlined speed selection.
- 60 feeds, 60 thread changes . . . all directly read.
- Automatic lubrication.
- Wide design carriage with 146 square inches of bearing surface on bed ways.
- Double-wall one piece totally enclosed apron with simplified controls.
- End gearing totally enclosed in self-lubricating housing.
- Power traverse heavy duty tailstock with rugged thrust lock.
- Rigid box girth design bed . . . hardened and ground steel bedways.

Write for new, fully descriptive Bulletin No. 213.

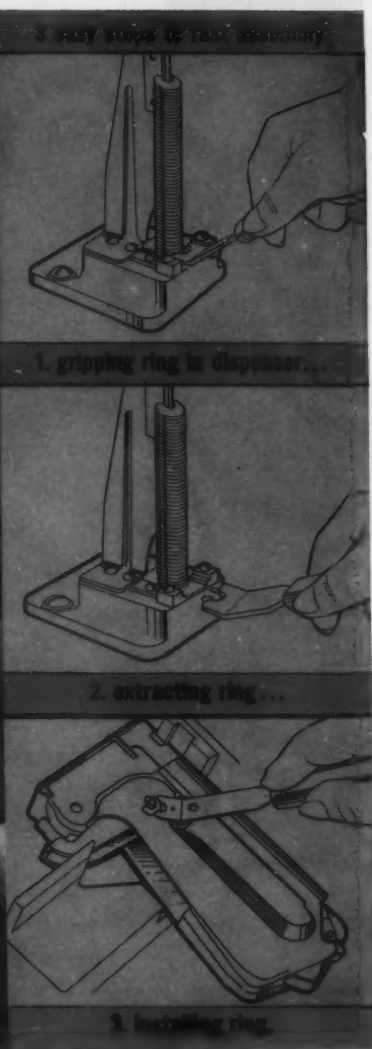
**Nebel Lathe Division • Nebel Machine Tool Corp.
3410 Central Parkway, Cincinnati 25, Ohio**

Other entirely new, proven design Nebel Lathes now available:

- Heavy Duty Model 2013 (Bulletin 212)
- Standard Duty Model 2516-20 (Bulletin 214)
- Heavy Duty Extension Bed Gap Lathe Model HXB 26/45 (Bulletin 211)



NEBEL MODEL 2516 HEAVY DUTY ENGINE LATHE



Truarc rings and dispenser speed staple gun assembly 60%

This big production increase was made by Swingline, Inc., Long Island City, N. Y. in assembling the handle lock of their high-compression staple gun.

To speed production, the Truarc Prong-Lock® Series 5139 retaining rings come *pre-stacked* for use on the Truarc dispenser (shown in foreground of photo above). Application is simple, fast and requires no skill. The operator, using the Truarc applicator, grasps the bottom ring, removes it from the stack, and installs it, quickly and easily, in the staple gun assembly.

The Truarc ring replaced an ordinary flat "C" washer, previously used in this application. *While the unit cost of the washer was lower than that of the Truarc retaining ring, the use of the rings resulted in assembled cost savings of \$25.00 per thousand staple guns.* The reasons: a 60% increase in production due to faster, easier assembly with Truarc tools, and the elimination of time-consuming, costly adjustments made possible by Truarc rings. What's more, the bowed Prong-Lock ring improved product design by providing resilient end-play take-up... eliminating looseness or binding in the parts.

Truarc retaining rings come in 50 functionally different types... as many as 97 different sizes within a type... 6 metal specifications and 13 finishes. Truarc assembly tools, pliers, applicators, dispensers and grooving tools are available to speed production of virtually every kind of product. Make sure you have on file the new 16-page Waldes Truarc Assembly Tool Catalog No. AT 10-58. Write for your copy today. And remember Waldes engineers are always ready to help you solve your special application problems. Waldes Kohinoor Inc., 47-16 Austel Place, Long Island City 1, N. Y.

© 1959 WALDES KOHINOOR, INC. D. 2



WALDES
TRUARC®
RETAINING RINGS

Waldes Kohinoor Inc., Long Island City 1, N. Y.

TRUARC RETAINING RINGS...THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS



announces

exclusive distributorship for

British-made PRECISION MACHINE TOOLS

★ LAPOINTE MACHINE COMPANY,

with its extensive sales and service staff, now offers a wide range of machine tools of exceptional quality.

★ REPRESENTING THE
ASSOCIATED BRITISH MACHINE TOOL MAKERS, LTD.

THE BUTLER MACHINE TOOL CO., LTD.

THE CHURCHILL MACHINE TOOL CO., LTD.

JOHN LANG & SONS, LTD.

J. PARKINSON & SON, LTD.

H. W. WARD & CO., LTD.

★ ALL FACILITIES OF THE LAPOINTE PLANT

in Hudson, Mass., including engineering and production personnel, are at the disposal of this line.

BUTLER



CHURCHILL



LANG



PARKINSON



WARD



ASSOCIATED BRITISH MACHINE TOOL MAKERS, LIMITED

Here's what brought it about:

Lapointe was the first American builder of metal-cutting machine tools to acquire a plant in Great Britain, and long association and acquaintance with British-made machine tools, used in the Lapointe plant since 1919, resulted in the development of a high regard for the quality of those tools and the integrity of their builders.

Lapointe selects best British machines. Consequently, with the world's changing trends in the marketing of machine tools, Lapointe recently decided to make a selection of the best British-built general and special purpose machines and sell them, fully tooled, in this country, using the complete Lapointe sales, service, and engineering structure in

this endeavor. The entire line is backed by the American Lapointe manufacturing plant, with its outstanding reputation as an important builder of machine tools.

Lapointe engineers inspect. Every British-made machine will be carefully inspected and checked-out by inspectors from the Lapointe plant in England, before shipping. Since these Lapointe men are thoroughly acquainted with the exacting requirements for machine tools in the United States, this procedure for final inspection provides complete assurance that the machine is *right*, and as ordered, before it leaves Britain.

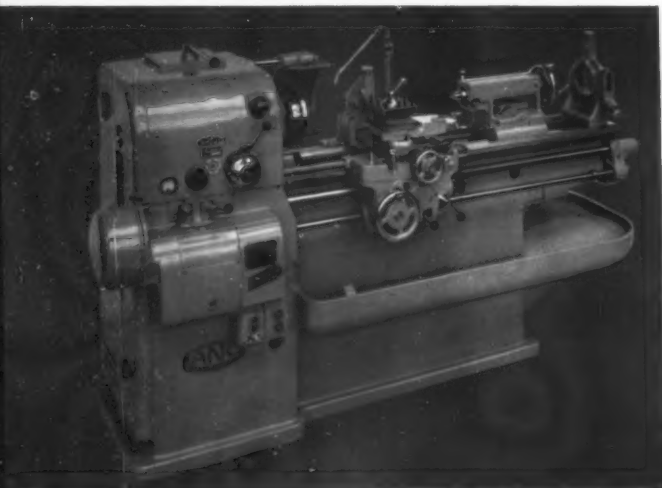
Parts readily available. A stock of

replacement parts will be maintained in Hudson, Mass., for quick shipment. There will also be blueprints in Hudson, from which to produce a part needed in an emergency, not carried in stock. All measurements are in inches; the English System avoids any conflict. The full complement of Lapointe service engineers and service men, including all the facilities of the large Hudson plant, will take care of any maintenance and tooling needs concerning these British machines.

Deliveries excellent. Some machines can be shipped from stock; others will be shipped on a schedule at least comparable to that required for similar machines from a machine tool builder in the United States.

Model J6 Lathe, 13" and 17" Swing

12 Spindle speeds — Nickel chrome, hardened and ground gears
• Pre-loaded spherical roller bearing spindle and the bearings pump lubricated with filtered oil • Totally enclosed multi-feed gear-box
• Pump lubrication to feed gear-box, apron and saddle • Hardened steel wear strips on under slideway faces of saddle • All controls conveniently grouped.



LAPOINTE LANG

Precision Engine Lathes

Precision Engine Lathes, 13-in. to 36-in. swing

Surfacing & Boring Lathes, 13-in. to 48-in. swing

Hollow Spindle Engine Lathes; hole through spindle 10½-in. dia., 12½-in. dia. and 16½-in. dia.

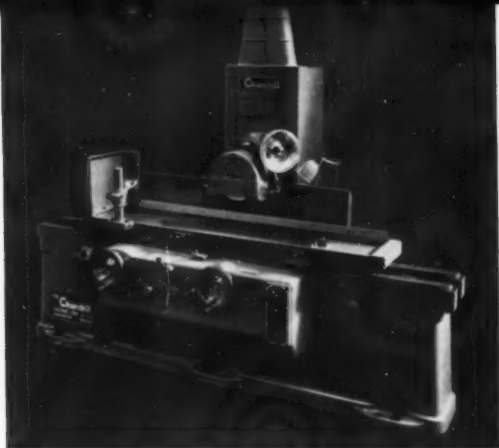
Sliding Bed Lathes, 30-in. and 36-in. swing

Unitrace Profiling Lathes, 16-in., 17-in. and 16/20-in. swing over bed

Hydrotrace Profiling Lathes, 20-in. and 24-in. swing over bed

Pneumatic and Hydraulic Chucks

For literature write to LAPOINTE



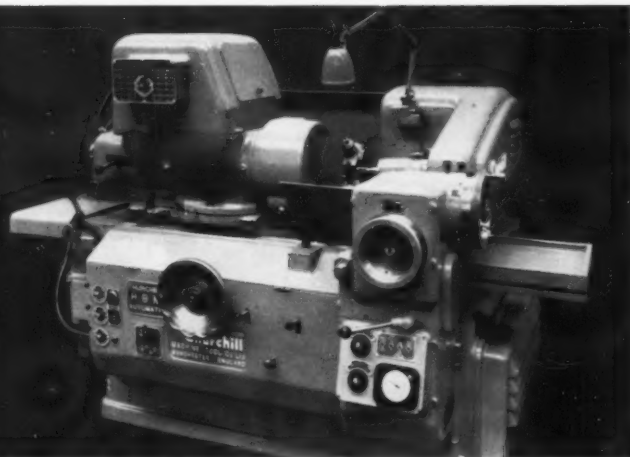
Model OSB Surface Grinding Machine
42" x 10" x 16"

LAPOINTE CHURCHILL

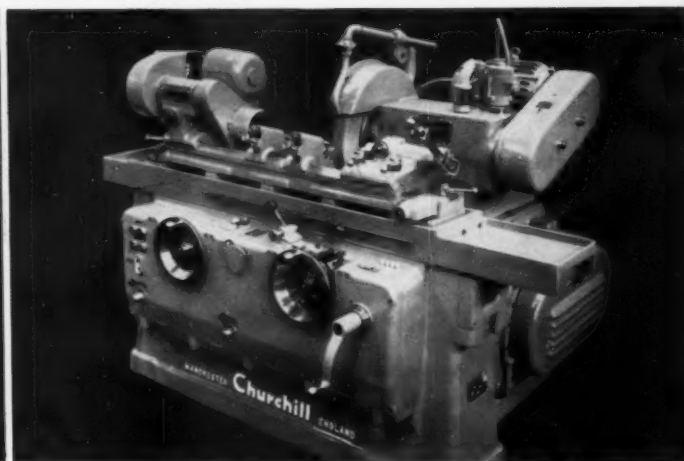
Precision Grinding Machines

Universal Grinders, 8-in. to 24-in. swing
 Universal Tool and Cutter Grinders, 8-in. to 12-in. swing
 Cylindrical Grinders, 6-in. to 60-in. swing
 Roll Grinders, Traveling Wheelhead and Moving Table Crankshaft Grinders
 Horizontal Spindle Surface Grinders, 6-in. to 15-in. wide table
 Horizontal Spindle Surface Grinders, Rotary Table
 Plano-Type Surface Grinders, horizontal and vertical spindle
 Vertical Spindle Surface Grinders, 10-in. to 22-in. wide table
 Plain Internal Grinders, 12-in. to 36-in. swing
 Automatic-Sizing Internal Grinders
 Internal Cylinder Grinders
 Centerless Grinders
 Spline Grinders
 Cam Grinders
 Slideway Grinders
 Grinding Machines for the Railroad Shop

For literature write to LAPOINTE



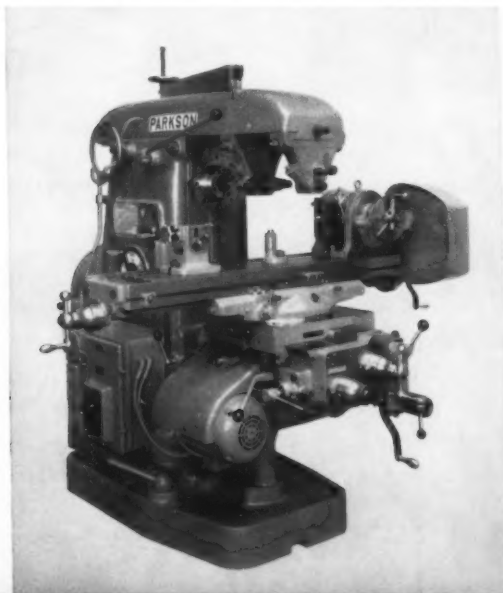
Model HBM Internal Grinding Machine



Model AW Plain Grinding Machine 6" x 18"

No. 2 NU Universal Miller

Table, 51" x 11½" • Longitudinal Feed, 28" • Cross Feed, 10" • Spindle Center to Table Top, max. 18" • Table Swivel each side of center, 50° • Spindle Speeds (12), 29 to 775 r.p.m. • Spindle Motor, 5 h.p. at 1430 r.p.m. • Feed Motor, 1½ h.p. at 950 r.p.m.



LAPOINTE PARKINSON

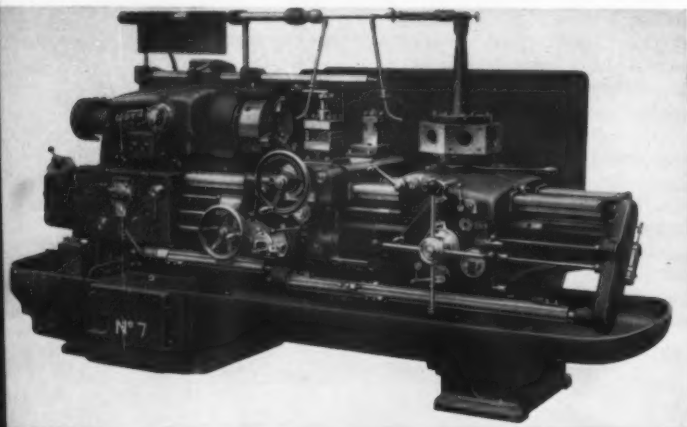
Milling Machines Gear Shapers

Plain Horizontal Milling Machines, knee type, 30-in. to 40-in. traverse
 Universal Milling Machines, knee type, 25-in. to 36-in. traverse
 Sunderland Gear Shapers for gears up to 15 ft. dia.
 Sunderland Gear Cutters
 Sunderland Gear Cutter Sharpening Machines
 Gearbur Machines

For literature write to LAPOINTE

No. 7 Prelector Turret Lathe

Patent hydraulic pre-selecting head-stock • 12 spindle speeds, both forward and reverse, (25-1,000 r.p.m.) • Bed protected by stainless steel covers • Screw-cutting motion • Automatic lubrication • Quick power traverse • 2½ in. bar 16 in. swing.



LAPOINTE WARD

Ram Type Turret Lathes Saddle Type Turret Lathes

- Ram Type Turret Lathes with bar capacity from 1¼-in. to 2-in. and swing from 13-in. to 16-in.
- Saddle Type Turret Lathes with bar capacity from 2½-in. to 8½-in. and swing from 16-in. to 35-in.
- Collet chucks, bar feeds, standard toolholders and special equipment for Ram Type and Saddle Type Lathes

For literature write to LAPOINTE

LAPOINTE BUTLER

Planers, Shapers, Slotters

Spiral-Electric Planers, double housing machines taking 3 ft. to 10 ft. between housings

Spiral-Electric Openside Planers; 4 ft. to 7 ft. under the rail

Spiral-Electric Rail Planers

Openside Crank Planers; 36-in. stroke

Hydraulic Openside Planers; 6 ft. and 8 ft. x 2 ft. 6 ins. x 2 ft. 6 ins.

Axlebox Planers; High Power, 24-in. stroke

Draw-Cut Shapers; various types up to 64-in. stroke

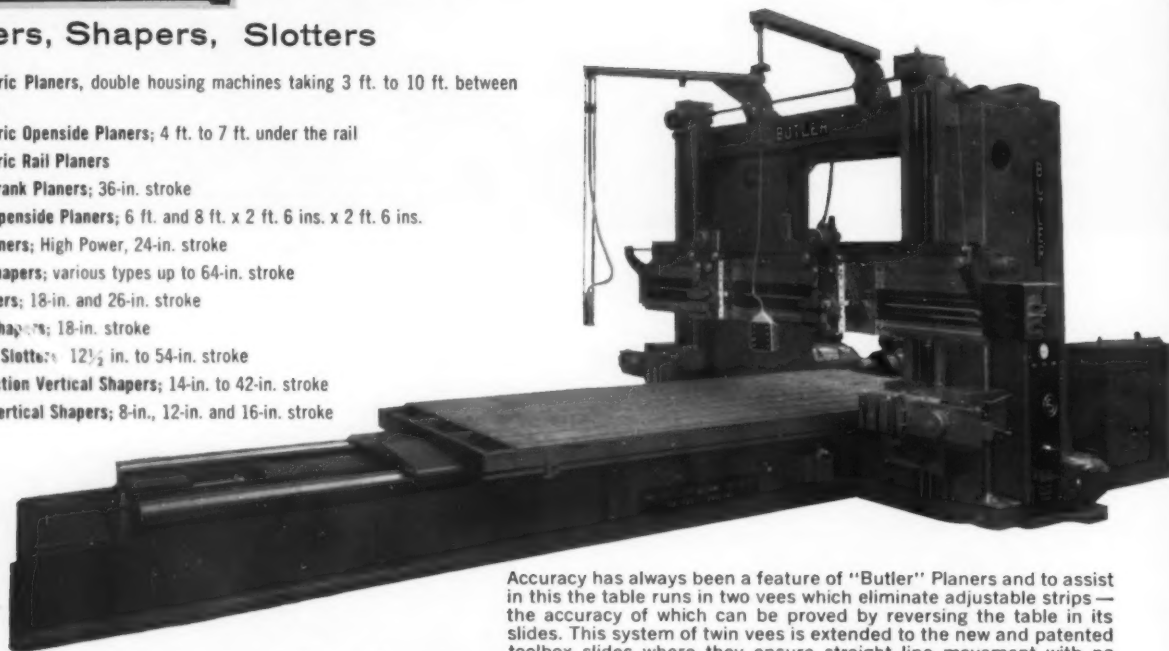
Super Shapers; 18-in. and 26-in. stroke

Hydraulic Shapers; 18-in. stroke

Heavy Duty Slotter; 12½ in. to 54-in. stroke

High-Production Vertical Shapers; 14-in. to 42-in. stroke

Precision Vertical Shapers; 8-in., 12-in. and 16-in. stroke



For literature write to LAPOINTE

Accuracy has always been a feature of "Butler" Planers and to assist in this the table runs in two vees which eliminate adjustable strips—the accuracy of which can be proved by reversing the table in its slides. This system of twin vees is extended to the new and patented toolbox slides where they ensure straight line movement with no loose adjusting strips.

Department M

LAPOINTE MACHINE COMPANY

HUDSON, MASSACHUSETTS

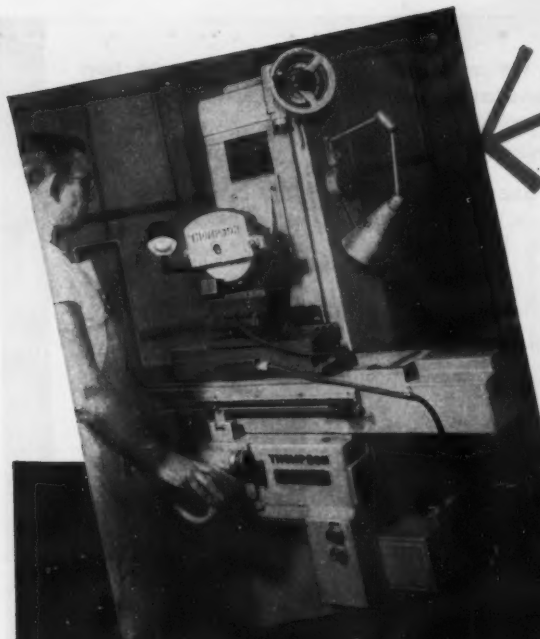
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British-made
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*Completely Satisfactory
in Every Way*

... says Mr. William H. Vogt, Division Superintendent of Parts and Tool Manufacturing at Taylor Instrument Companies, Rochester, N. Y.



NEW

TYPE D

Hand Feed SURFACE GRINDER

**is ruggedly designed
for precision work.**

With men like Mr. Vogt, who rate tool room grinders solely on their performance, Thompson's new Type D machine is winning enthusiastic approval.

Send for descriptive literature on this new Type D machine and compare the advantages it offers you in cost-cutting time-saving and trouble-free performance. Immediate delivery is available.

THE THOMPSON GRINDER CO.

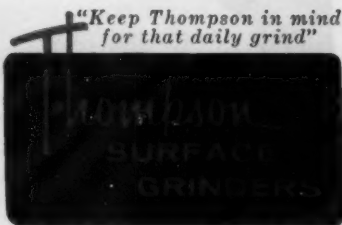
SPRINGFIELD, OHIO

MACHINERY, January, 1960

For more data circle this page number on card at back of book

37

<p>OFFICES IN ALL PRINCIPAL CITIES</p>		<p>Taylor Instrument Companies</p>	
<p>For the Home: THERMISTORS & RESISTOR INSTRUMENTS</p>		<p>For Industry: TEMPERATURE PRESSURE HUMIDITY FLOW & LIQUID LEVEL INSTRUMENTS</p>	
<p>SUBSIDIARIES IN: TORONTO CANADA LONDON ENGLAND MELBOURNE AUSTRALIA</p>		<p>95 AILES STREET ROCHESTER 1, N.Y., U.S.A. May 7, 1959</p>	
<p>Mr. John C. Wilson, Vice-President, Sales & Engineering The Thompson Grinder Company Springfield, Ohio</p>			
<p>Subject: THOMPSON Type D Surface Grinder</p>			
<p>Dear John:</p>			
<p>We have proven the new Thompson Type D Tool Room Grinder by rigid tests in our Tool Grinding Department. We find it completely satisfactory in every way.</p>			
<p>We find these decided advantages on the new Thompson:</p>			
<ol style="list-style-type: none"> 1. Its ease of adjustment 2. Its ruggedness and rigidity 3. Its bedway and column protection 4. Its large vertical capacity 5. Its cross-feed movement obtained by moving the wheel head rather than using a saddle, which permits accurate grinding of slots. 			
<p>Everything considered, we find, in our work, the new Thompson Type D a very superior precision machine.</p>			
<p>Yours very truly,</p>			
<p><i>William H. Vogt</i></p>			
<p>William H. Vogt Division Superintendent Parts and Tool Manufacturing</p>			
<p>whv:lb</p>			



when
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... he speaks for the country's top manufacturers,* who depend on TMW for the very best in sub-contract components, assemblies, machines.

Leading manufacturers don't gamble on quality, accuracy, and on-time delivery of sub-contract work. It has to be *right* and it has to be *there* when it's needed.

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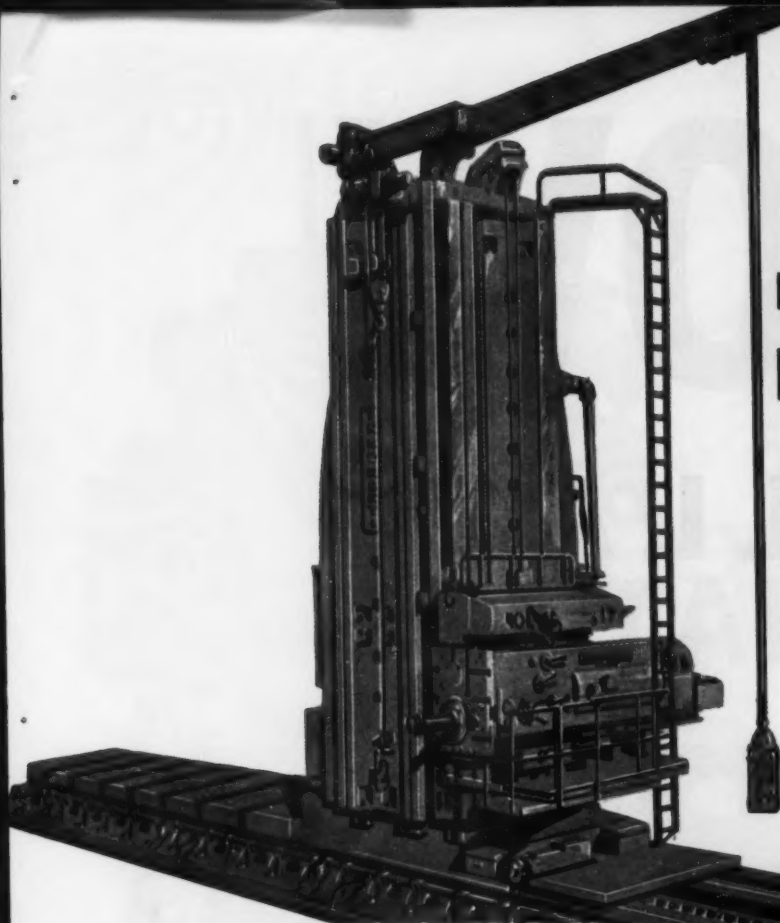
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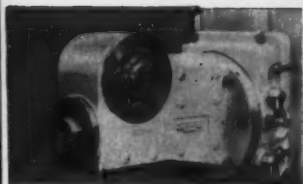


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The **INNOCENTI** CWB milling and boring machine allows the solution of the most difficult working problems in the most rational way. This is achieved thanks to the exceptional performances of the machine and to the variety and flexibility of the equipment used with the machine.

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FIRST

FULLY POWER-CONTROLLED

Dynatrol V.T.L. has Bullard's new Dynamic Precision Control... a fully powered machine tool control system which pays off in greater production.

Dynamic Precision Control keeps the tool in the cut more of the time... cuts time between cuts... increases the operating speed and output of the machine.

Dynatrol provides **infinitely variable feed rates** throughout the full range and **variable traverse rates** from zero to nine feet per minute. Dynatrol provides complete flexibility of control both in and out of the cut. Feed rates may be advanced or retarded while the machine is cutting to obtain maximum tool performance and productivity.

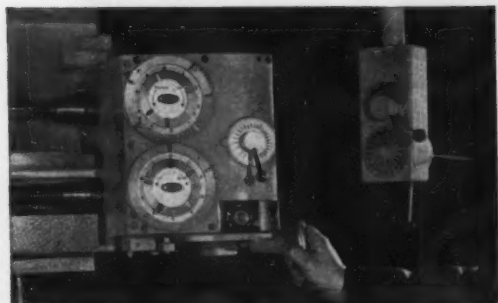
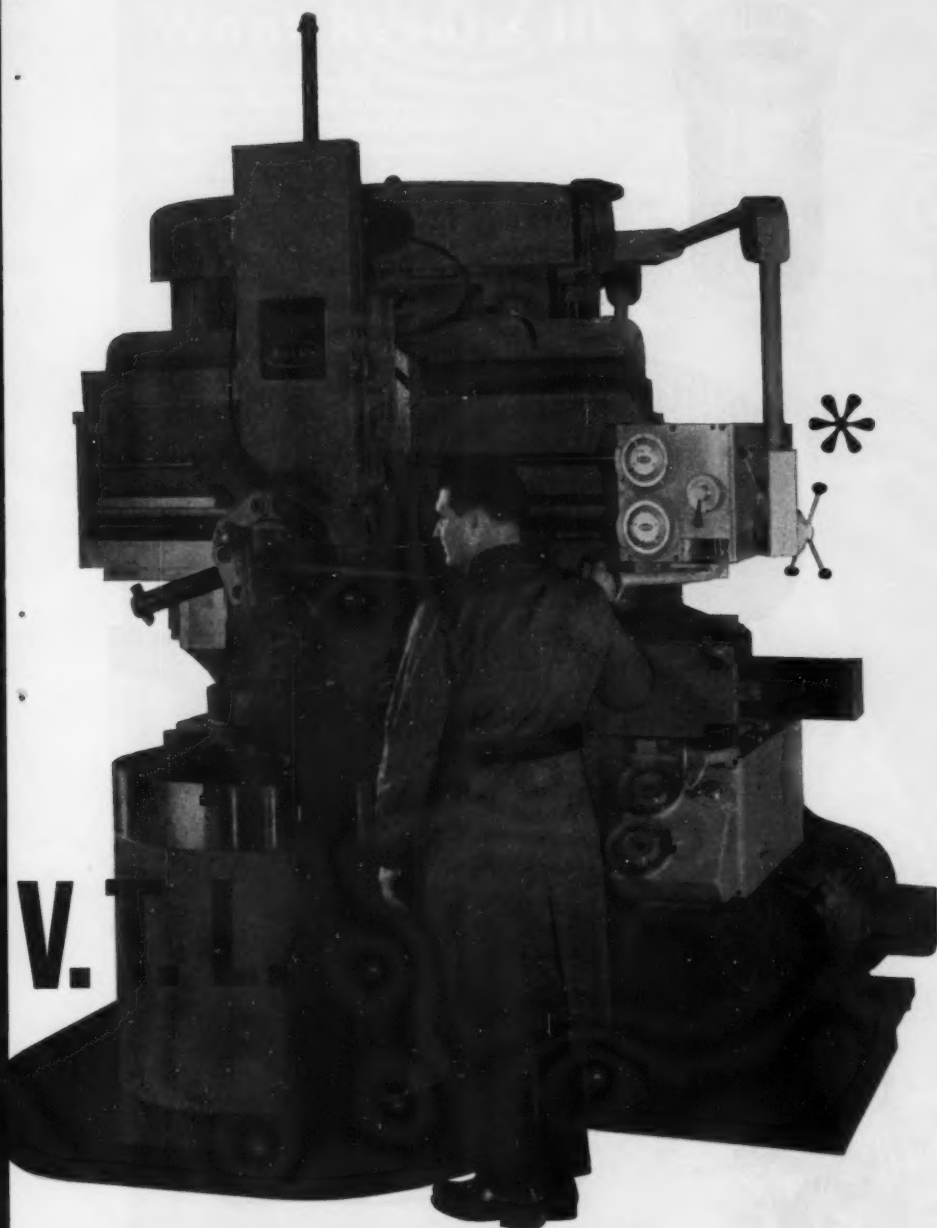
Dynatrol provides **single lever control for all motions of each head**. Variable traverse rates, feed engagement and full directional motions are obtained through one lever located in the most advantageous position for the convenience of the operator. Equally simple remote controls are available for machines of all sizes. Nine sizes from 26" to 124" table diameter.

Send to The Bullard Company, Bridgeport 9, Connecticut, for detailed catalog. Telephone EDison 6-2511.

*Trademark



"YOU CAN'T



This is the control center of the new Dynatrol V.T.L. Feed rates, infinitely variable from zero to maximum, are directly geared to table rpm. A simple pendant controls start, stop and speed of table.

BEAT A BULLARD"

High-Spot Features of the DYNATROL® V.T.L.

Dynatrol V.T.L. is POWER CONTROLLED

By lever or pendant — it's your choice — head traverse rates can be varied from zero to nine feet per minute. Easy-to-read dials show exact position.

Feed selector gives infinitely variable feed rate without interrupting the cut.

Dynatrol V.T.L. is VERSATILE

Available equipment includes:

Bullard variable speed drive for infinitely variable table speeds throughout the full range with no loss of usable horsepower.

Fully automatic operation by Bullard Man-Au-Trol or point-to-point or continuous path numerical control systems.

Unique Size-Au-Trol* for accurate positioning of all heads. Contouring attachments: Hydraulic, electronic or electro-hydraulic. Four- or five-sided power-indexing turret heads. Thread cutting, drum scoring and angle turning attachment. Power-operated chucks.

Dynatrol V.T.L. is COMPACT

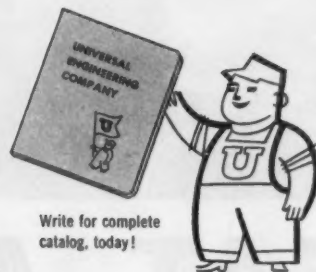
The new Bullard Dynatrol V.T.L. is compact in design, rigid in construction, lower in height, reduced in floor area.

**Dynatrol V.T.L. is
EASY TO MAINTAIN**
Automatic lubrication throughout... fewer parts... fewer adjustments... easily accessible.



for speed and accuracy in production
it pays to use UNIVERSAL DRILL BUSHINGS

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 2, MICH.



Write for complete
catalog, today!

214

Want Results like this?

This sales engineer reports another dramatic success in the heavy duty application of CIMPRIAL, new chemical cutting fluid of the famous CIMCOOL line. Production up — on low clearance, low speed, heavy cut jobs previously limited to cutting oils. (Company name on request)

SALES REPORT

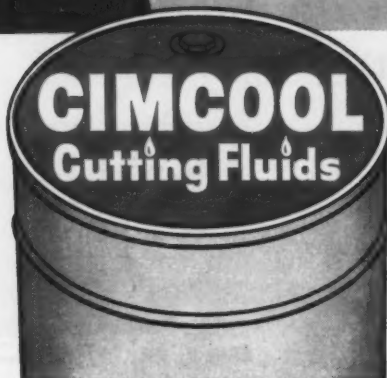
2

truck manufacturer. They were using a straight cutting oil on a crank-shaft lathe operation and were getting so much smoke the union complained.

The company was planning to install an expensive special exhaust system when they tried Cimprial. Operators like its performance and complete absence of smoke. Union dropped complaint.

Cimprial now in 10 lathes at 1:20 dilution at cost of only 10¢ per gallon of mix. They previously used straight cutting oil at 49¢ per gallon.

Ed Kennedy
New York office



FOR 100% OF ALL METAL CUTTING JOBS

Production-proved products of The Cincinnati Milling Machine Co.

CIMCOOL S2 Concentrate—The pink fluid which covers 85% of all metal cutting jobs.
CIMPRIAL—newest in the famous, industry-proven line of Cimcool® Cutting Fluids.
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ALSO—CIMCOOL Tapping Compound—CIMCOOL Bactericide—CIMCOOL Machine Cleaner.

For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

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Get new-forging performance at 1/3 the cost from **ERIE FOUNDRY REBUILDING SERVICE**

Here at the Erie Foundry Rebuilding "Hospital", we disassemble and inspect your forging hammer, remachine worn surfaces, true bearings, replace broken parts, repair cracked parts. Once the hammer is reassembled, tested and put back in operation, it'll be as spry and sound as a new machine—but at one-third the cost!

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Regardless of who made it, or how badly it's cracked, broken or worn, your forging hammer will recover most quickly at Erie Foundry's Rebuilding "Hospital". Write for the complete story.



THE WORLD'S GREATEST NAME
IN FORGING SINCE 1895

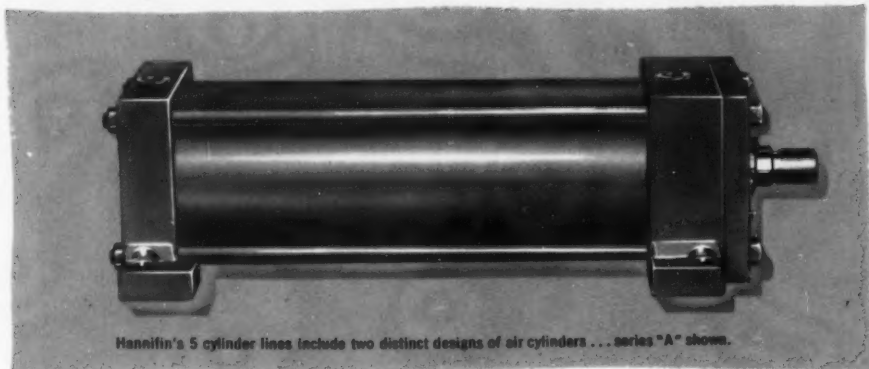
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ERIE 5, PA.

EF-59-02

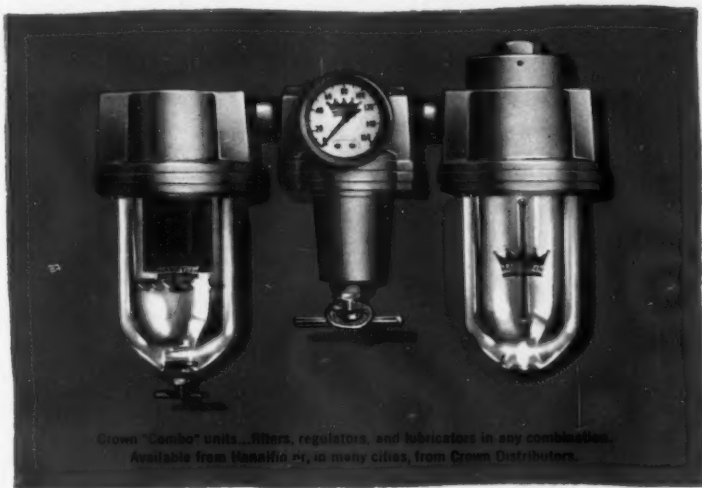
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MACHINERY, January, 1960

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS



Hannifin's 5 cylinder lines include two distinct designs of air cylinders... series "A" shown.



Crown "Camber" units... filters, regulators, and lubricators in any combination. Available from Hannifin Co. in many cities, from Crown Distributors.

Only **HANNIFIN** makes all these **AIR POWER** **COMPONENTS**



Hannifin valves take many forms. This 3/4" 4-way valve out-performs many a competing 1/2" valve.

Anywhere you use compressed air to do work, Hannifin can help you. Hannifin cylinders for the "muscles". . . Hannifin air valves for any type of actuation, hand, foot, cam, solenoid, or pressure . . . the Hannifin "Crown" Line of filters, regulators, and lubricators for lasting air power efficiency . . . all are built by Hannifin to just one standard, the best.

Turn to Hannifin, too, for expert help in applying air power components. A Hannifin field engineer is as close to you as your telephone, wherever you are. Write us for his address—or, he's listed in the alphabetical section of Thomas Register. It's that easy.

HANNIFIN COMPANY

505 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION

FOR NUMERICAL CONTROL AT LOWEST COST

put
your
**short
runs**
here



Illustrated here is a Gorton Mastermil with G-16A Super-Speed Spindle Head and Ram Assembly with G. E. Mark II Numerical Control System

GORTON NUMERICAL CONTROL is field tested and proved in use

This is how Gorton Numerical Control saves you money on short runs:

- eliminates elaborate and costly tools, dies, jigs and fixtures
- wastes no time because operator does not "pace" the work
- makes no mistakes because operator skill not required
- extreme, repetitive accuracy is easy and automatic
- change overs in set-ups can be made quickly
- signals operator when tool changes are needed
- guides cutter in close quarters without damage to work or cutter
- making punched tape is simple typewriter operation

Punched tape... or magnetic tape control... is available to you on SIX standard Gorton machines and also on Gorton custom-designed machines. You'll be agreeably surprised when you learn the low cost of Gorton Numerical Control and how much more it gives you for your money. For full information write

Saves You Money on —

- face milling
- side milling
- end milling
- straight line cavity milling
- slotting
- drilling
- reaming and boring



GEORGE GORTON MACHINE CO.

1301 Racine St. • Racine, Wis.

SINCE 1893

Tracer-Controlled Pantographs, Duplicators — standard and special... Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.



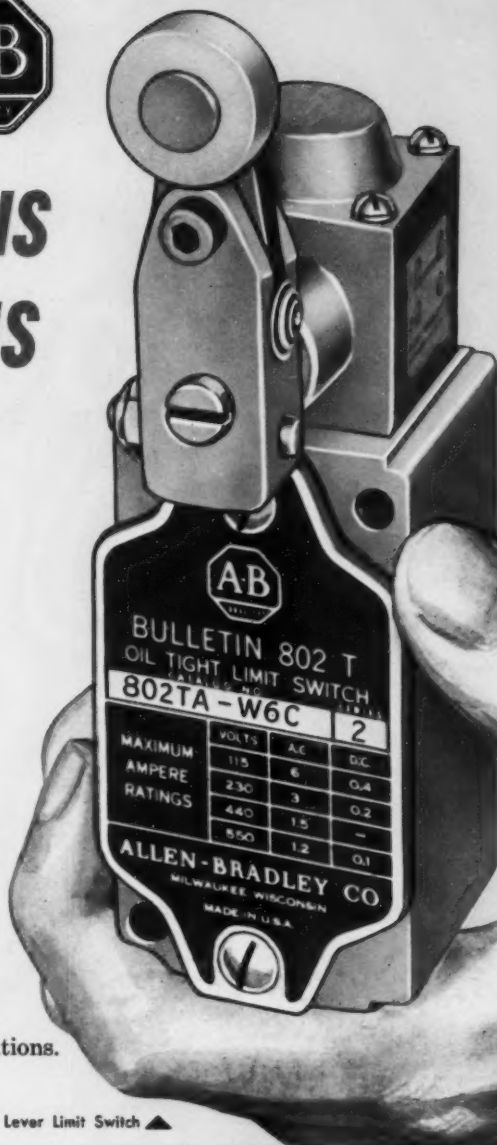
MORE MILLIONS OF OPERATIONS

with

Allen-Bradley Limit Switches

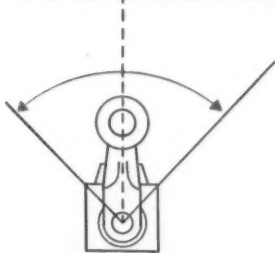
There's nothing now on the market to match the reliability and trouble free performance of Allen-Bradley Bulletin 802T limit switches. They are completely oiltight—operating heads and switch bodies are sealed against oils, coolants, and metal chips. Operators cannot become sluggish or "stick" in operation—contacts cannot become fouled. The double break, silver contacts are always in perfect operating condition—and remain so without maintenance.

Insist on Allen-Bradley—the *quality* line of limit switches that will give you *many more millions* of trouble free operations.

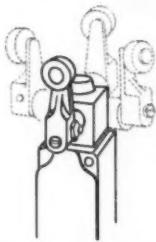


Bulletin 802T Micrometer Adjustment Roller Lever Limit Switch ▲

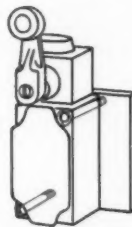
A-B Limit Switch features mean more life, more dependable trouble free service



REPETITIVE ACCURACY—Unique toggle blade action assures operation at precisely the same point each time, without adjustment.

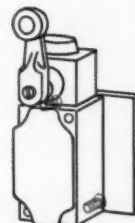


FLEXIBILITY—All operating heads can be rotated and fastened in any of four positions 90° apart.



FRONT MOUNTING

All Allen-Bradley Limit Switches can be mounted either from the front ... or from the rear.



REAR MOUNTING

1-60-MR

SEE OTHER SIDE FOR TYPICAL APPLICATIONS →

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

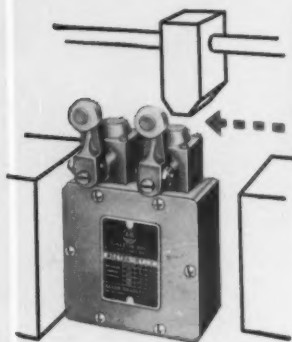
QUALITY MOTOR CONTROL

Allen-Bradley has an Oiltight Limit Switch to meet your exact needs!

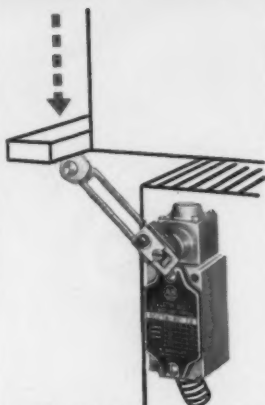
From among the wide variety of Allen-Bradley oiltight limit switches, you are certain to find the exact type to satisfy your specific requirements. If you do not, then please discuss your problem with us. A-B limit switches are available with many different levers, lever-contact actions, operating forces, and actuator motions—in spring return or maintained contact construction. A new 16-page illustrated booklet on this *quality* line of A-B oiltight limit switches is just off the press. Write for it!



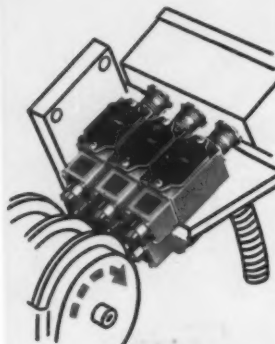
Roller lever limit switch—
Here it is operated by dog
on vertically moving shaft.



Duplex limit switch where
block can also trip second
switch for safety insurance.



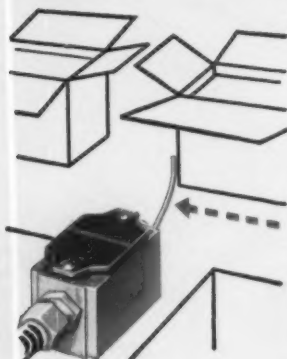
Adjustable roller lever
switch. Lever set for operation
at greater than normal distance.



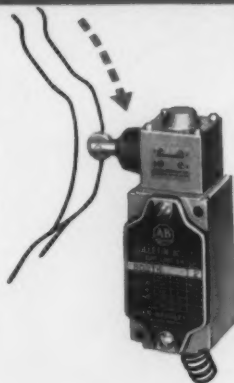
Top push roller limit switches
are frequently operated by
rotating cams on machine tools.



Neutral position switch—
moving bar closes separate
contacts as it moves each way.



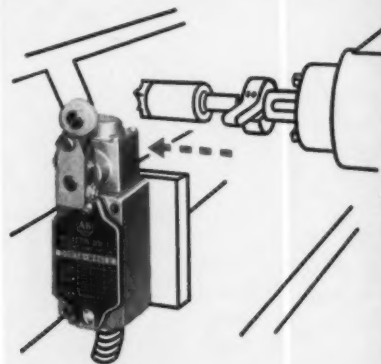
Cat's whisker limit switch
is actuated by movement of
lightweight units on conveyor.



Side roller limit switch, as
illustrated here, is being ac-
tuated by a rotating cam.



**Fork lever maintained con-
tact switch—adjustable dogs**
trip one roller in each direction.



Micrometer adjustment
switch for precise setting of trip
point in machine tool operations.

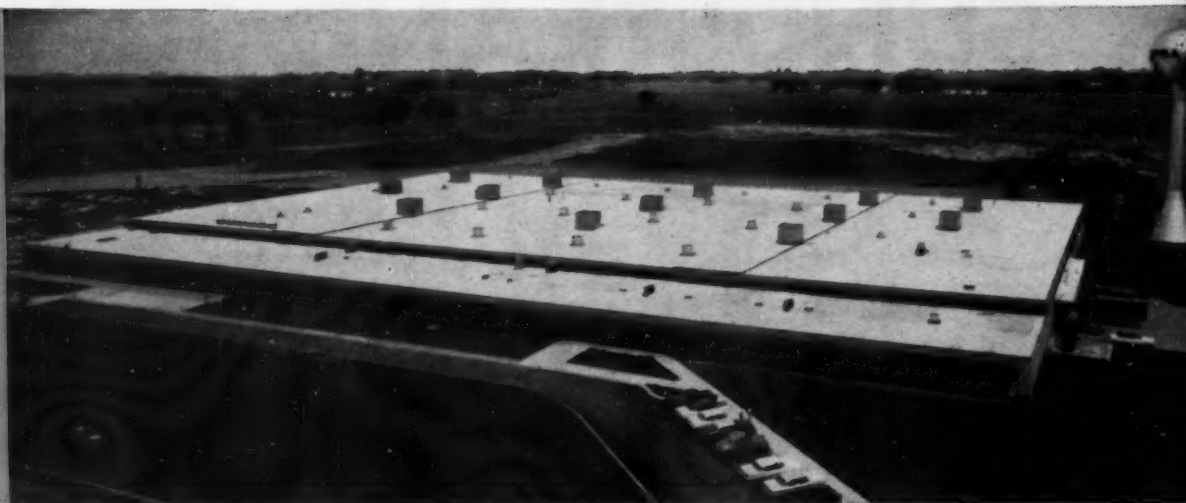
1-60-MR

ALLEN-BRADLEY

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Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

**QUALITY
MOTOR
CONTROL**



Motorola Qunicy, Illinois plant

Equipment Replacement Considerations in the Electronics Industry

by

WILLIAM A. WATT

Assistant to Vice President
of Manufacturing
MOTOROLA INC.
Chicago, Illinois

"MOTOROLA — the world's largest electronic manufacturer — has after much study chosen to use a modification of the MAPI formula in determining the economic advantage of replacing present equipment with new equipment.

"In any industry, and especially in one that is as competitive as electronics, it is mandatory that a continuous surveillance be maintained to gain the greatest return on investment. It is of the utmost importance that product reliability and engineering advances be considered to have at least equally strong import as the economics when there are such dynamics in the state of the art, and when the customer demands and requires flawless reliability.

"Motorola has chosen the policy of evaluating the expenditure for all new equipment by using a re-equipment analysis and operation comparison form. This forces the individual to complete the thought process with an unbiased and complete review of the effects upon return on investment, reliability, and anticipated engineering advances.

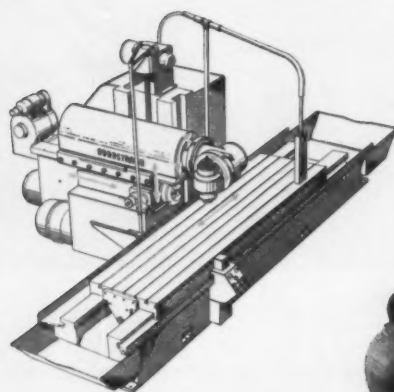
"We find that this has enabled us to have a more scientific approach in our evaluation of equipment replacement."

ROCKFORD INSERT GROUP

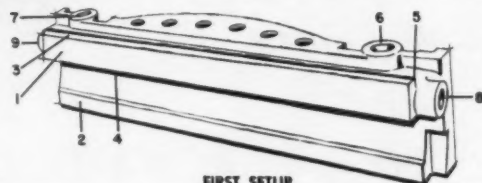
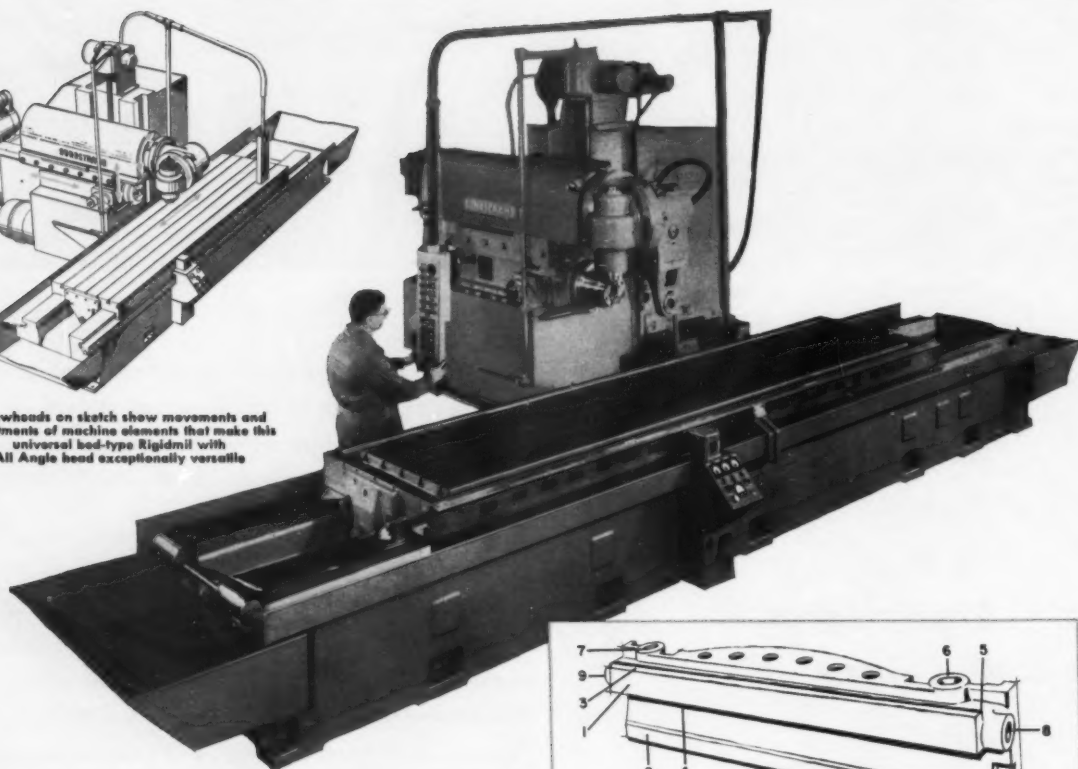
January, 1960

KEEP GATHERING METAL WORKING PRODUCTION IDEAS... BE WELL INFORMED WHEN YOU REPLACE MACHINERY AND EQUIPMENT...

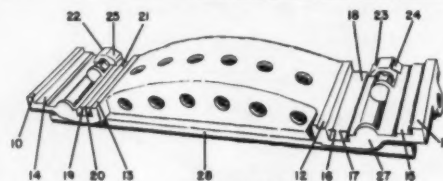
SUNDSTRAND 50-hp machines 28



Arrowheads on sketch show movements and adjustments of machine elements that make this universal bed-type Rigidmil with All Angle head exceptionally versatile



FIRST SETUP



SECOND SETUP

● Do you need a machine that has rigidity and power for a wide range of cuts and adds versatility to reduce parts handling and the need for expensive, special fixturing? If you do, then the universal bed-type Rigidmil with All Angle head was practically designed for you. The 28 surfaces machined in the two setups shown are typical of the range of operations readily handled on this machine.

Both the horizontal spindle head and the All Angle ram type head have the horsepower needed to handle sizable cuts. Horizontal spindle provides 50-hp maximum, and the All Angle head 20-hp maximum.

Up to 216 inches table feed stroke . . . $\frac{3}{4}$ to 220 inches per minute longitudinal table feed . . . $\frac{3}{4}$ to 100 ipm transverse column feed . . . $\frac{3}{4}$ to 50 ipm head feed . . . pushbutton control of

machine speeds and movements . . . these are some of the features that indicate the machine's ability to handle a broad range of work. Slab milling can also be performed using the main spindle and mounting an arbor support on the dovetail ways provided in the machine's design.



*"Engineered
Production
Service"*
1960 S.S. INC. DIV.

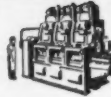
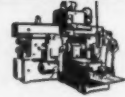
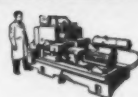
AUTOMATIC LATHES

SIMPLEX RIGIDMILS

DUPLIX RIGIDMILS

TRIPLIX RIGIDMILS

SPECIAL MACHINES



Machinery, January, 1960

CENTER OF MACHINE-TOOL EXCELLENCE

ROCKFORD, ILLINOIS, U.S.A.

RIGIDMIL

surfaces in just 2 setups

Positioning cutter instead of work reduces setup time

HERE'S HOW TO CUT SETUP TIME . . . Sizable cuts are taken with both the All Angle head and the main horizontal spindle so that production rate stays high despite the unparalleled flexibility. Carbide cutters are used to full advantage on both spindles as shown in typical operations below. Accuracy invariably exceeds that possible on conventional machines because of reduced parts handling. Surfaces 1 to 9 machined in first setup. Surfaces 10 to 28 machined in second setup.



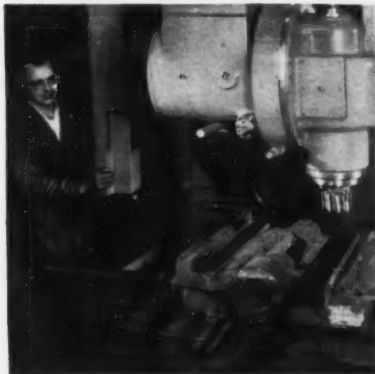
HORIZONTAL SPINDLE and longitudinal table feed are used for face milling first surfaces of large casting.



MACHINING ON TOP of the work is illustrated in this example using the All Angle head and longitudinal table feed.



ANOTHER EXAMPLE of the ease with which it is possible to move the cutter instead of workpiece is on this step using All Angle head and vertical feed.



ANOTHER POSSIBLE combination of machine movements is shown here where All Angle head in vertical position is coupled with transverse feed.



ALL ANGLE HEAD is used to mill clearance cuts at an angle using transverse feed. All power feeds are infinitely variable.



HORIZONTAL SPINDLE returns to action in combination with longitudinal table feed. Power operated drawrod (extra) for horizontal spindle makes cutter changing easier.

ADDITIONAL DATA describing the universal bed-type Rigidmil with All Angle head is available in Bulletin 611. Write for your copy today!

SUNDSTRAND MACHINE TOOL
DIVISION OF SUNDSTRAND CORPORATION
BELVIDERE, ILLINOIS



BROACHING TOOLS	THREE WAY	SINGLE RAM	HORIZONTAL	DUPLEX RAM	PRESSES



"Engineered Production Service"
1903-1954

Machinery, January, 1960

CITY OF MACHINE-TOOL SPECIALISTS

ROCKFORD, ILLINOIS, U.S.A.





The new Barber-Colman Model 1610 Facing and Turning Lathe is designed specifically for facing, turning, and boring. It is highly economical for either toolroom or production work.

This lathe has no threading equipment. This means more lathe per dollar for your facing and turning work. It can be furnished with a front-mounted tracer that is

ideally suited for both small-lot and high-production turning. Either 16" or 20" swing over the bed ways is available.

Today, a high percentage of lathes are used only for facing, turning, and boring. Thus, elimination of threading equipment and the gear box permits a sizable saving in purchase price with no practical loss of utility. You get a low-cost

precision lathe capable of producing toolroom accuracies easily.

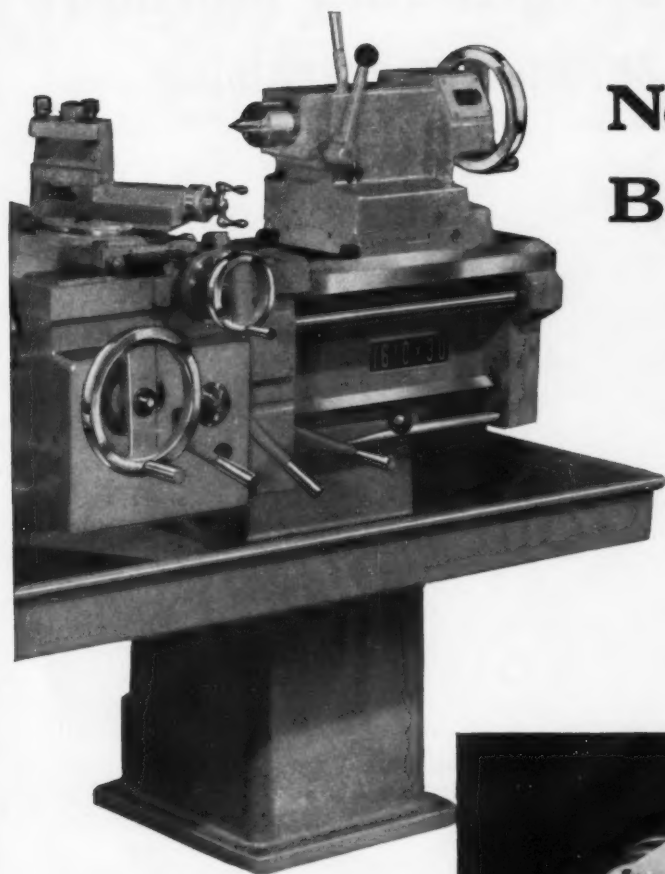
Elimination of the gear box permits infinitely variable feed. Feed rate is changed simply by turning a dial on the headstock. It can be as fine as .0001", depending upon spindle speed. Spindle speeds also are infinitely variable. Maximum speed can be 1500, 2000, or 2500 rpm. The drive motor is 6.5 hp.



Machinery, January, 1960

CENTER OF MACHINE-TOOL EXCELLENCE

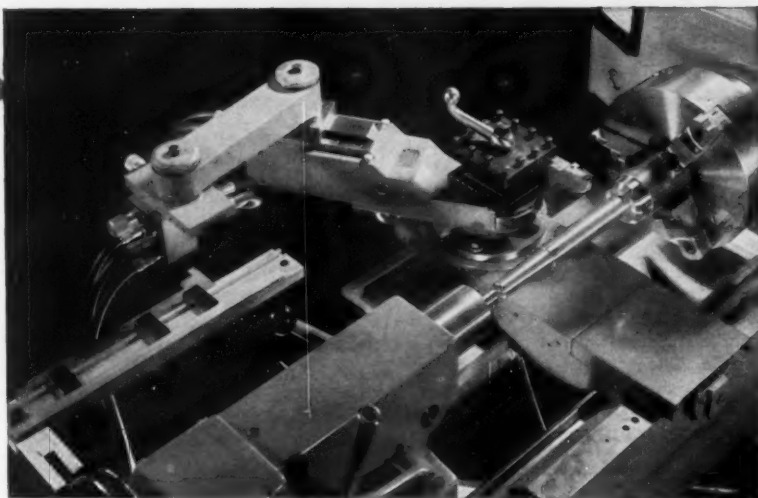
ROCKFORD, ILLINOIS, U.S.A.



Model 1610 Lathe with front-mounted tracer unit.

New Barber-Colman Lathe

Model 1610 Facing and
Turning Lathe . . .
16" or 20" Swing



Other important features include automatic carriage stops with a 5-position turret stop, and a tail-stock travel counter.

The simple hydraulic tracer is easy to mount, easy to set up, and easy to operate. Stepped diameters, 90° faces, chamfers, contours, and tapers all can be turned at the lowest possible cost. The tracer is front-mounted and uses a flat

template. With it, parts can be turned easily within .001" on diameter and .001" on length. Swing over the cross slide with tracer is 10" on the Model 1610 and 13" on the Model 1610-13.

Ask your Barber-Colman representative about the complete features of this new practical kind of lathe. Or write direct to the factory for more information.

Barber-Colman Company



12 Loomis Street, Rockford, Illinois

Machinery, January, 1960

FOR PRODUCTION MACHINE TOOLS IT'S

ROCKFORD, ILLINOIS, U.S.A.



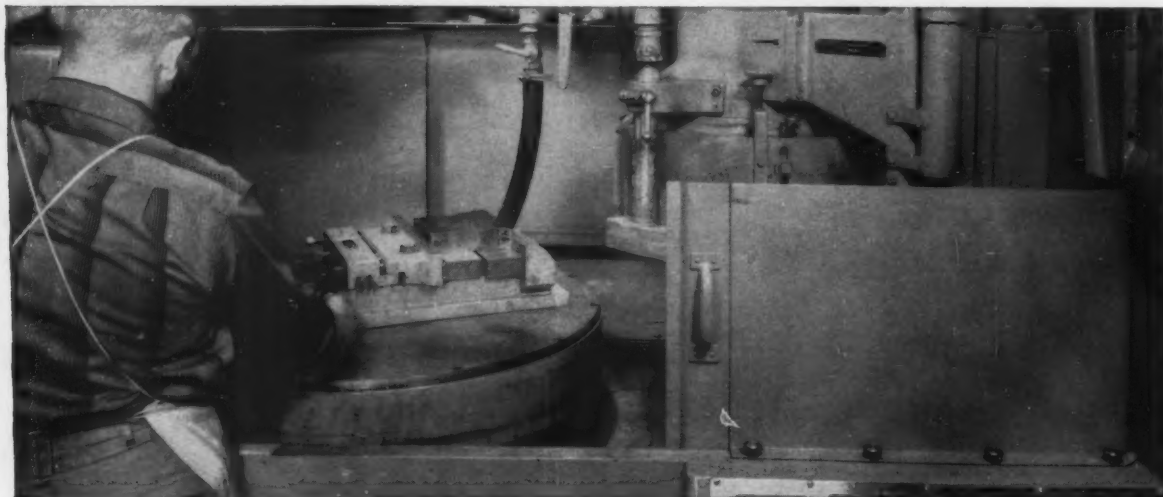
MATTISON
HIGH-POWERED
PRECISION

**GRINDING
METHODS**

Fast, new grinding method replaces cutter-type machining

.....

Betters production time by 75% . . removes
up to ¼ in. stock per side . . . economically



Courtesy: Alignment Engineering Co., Warren, Michigan

Fig. 1—No. 24 vertical-spindle rotary pulls up to 60 hp through the spindle. Grinding mild steel, this rugged machine removes metal up to three

times faster than conventional surface grinders. With this in mind, many plants (like this one) are buying them as a stock-removal tool.

Three shapers replaced . . . machining time cut from 6 to 1½ hr. . . up to ¼ in. stock removal per side economical with new method . . .

These are results from a Michigan company (typical jobs shown) after installation of a Mattison No. 24 vertical-spindle surface grinder with Quick-Tilt spindle. Such performance proves that a rigid, high-powered vertical is now . . . more than ever . . . a stock-removal machine as well as a precision grinder.

Two machines for the price of one Until the introduction of the Quick-Tilt spindle rotary late last year, grinding



Fig. 2—Quick-Tilt improves accuracy, too. Parts requiring extremely close tolerances can be ground faster, utilizing full table capacity.

dead flat parts on a production basis meant you had to accept one of two types of inefficiency: (1) excessive downtime for changing one machine from a rougher to a finisher . . . or (2) "two-timing"—keeping two grinders set up for successive roughing and finishing.

Now, a flick of the switch tilts the spindle for rough and finish operations in a single setup, without even stopping the machine. In effect, this gives you two machines for the price of one. But, that's only part of the story.

The Quick-Tilt rotary does more than provide a dual cycle on one grinder. It combines high horsepower (60 on the No. 24—100 on the No. 36) and rugged construction, with the best features available for precision, fine-finish work.

Hidden savings a big factor

Another reason why it pays to own a new Mattison is reduction of hidden costs. You can reduce your stock allowances for grinding and eliminate cutter-type machining of flat surfaces. With self-dressing wheels, machine downtime for changing the cutting tool and cost of re-sharpening can be eliminated. This is important because actual machining time on a surface grinder is often less than on a machine that produces much bigger

chips. Improved finish and accuracy are a bonus. And don't forget—hard spots, burned edges, and tough outer scale are no problem for a grinding wheel.

To the grinding man all these advantages add up to *maximum versatility in a standard machine.*

Ask for a test grind

We don't expect you to rush through a purchase order for a new grinder on the strength of this ad. But, if it seems to make sense in terms of your particular machining problems and costs, we do hope you'll investigate further. Send us your piece-parts for a sample grind in the Mattison Methods Lab. There's no cost (other than shipping expense) for a complete report covering stock removal, wheel life, production rate, wheel specs, surface finish, accuracy, etc. Your Mattison dealer will make all the arrangements—or, phone the factory direct.

MATTISON MACHINE WORKS
Rockford, Illinois • Woodland 2-5521



**HIGH-POWERED
PRECISION
SURFACE GRINDERS**



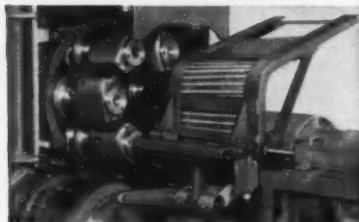
Machinery, January, 1960

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

Second Operation



MAGAZINE LOADING



REAR LOADING MAGAZINE



HAND LOADING

A Method of Machining That Pays Off

Greenlee standard Automatic Bar Machines, adapted for second operation work, profitably machine a wide variety of parts. Long shafts or short pieces are automatically loaded into the work spindle by any of the various loading arrangements shown. Parts are loaded in one position during the machining cycle, and machined in the remaining five cross slide and end working positions. For more information, see your Greenlee Distributor.

GREENLEE STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Die Casting Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines

WRITE FOR CATALOG No. A-405

GREENLEE
BROS. & CO.

1744 MASON AVE.
ROCKFORD, ILL.

Machinery, January, 1960

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**



....only with hydraulic design

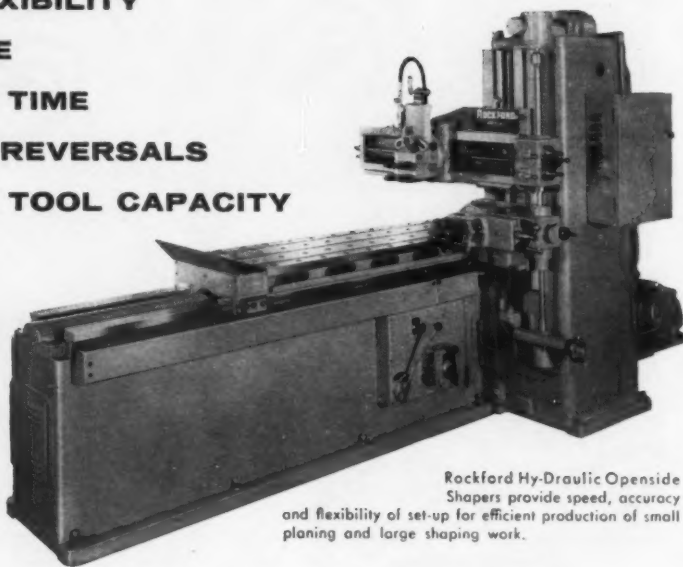
GREAT SET-UP FLEXIBILITY

WIDE WORK RANGE

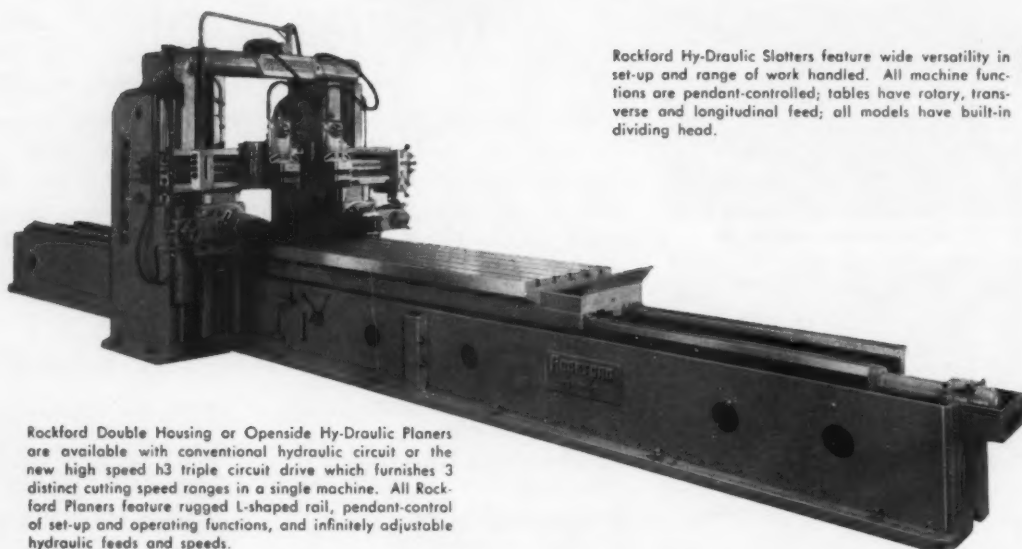
SHORT MACHINING TIME

HIGH-SPEED, FAST REVERSALS

NATURAL CARBIDE TOOL CAPACITY



Rockford Hy-Draulic Openside Shapers provide speed, accuracy and flexibility of set-up for efficient production of small planing and large shaping work.



Rockford Hy-Draulic Slotters feature wide versatility in set-up and range of work handled. All machine functions are pendant-controlled; tables have rotary, transverse and longitudinal feed; all models have built-in dividing head.

Rockford Double Housing or Openside Hy-Draulic Planers are available with conventional hydraulic circuit or the new high speed h3 triple circuit drive which furnishes 3 distinct cutting speed ranges in a single machine. All Rockford Planers feature rugged L-shaped rail, pendant-control of set-up and operating functions, and infinitely adjustable hydraulic feeds and speeds.



Machinery, January, 1960

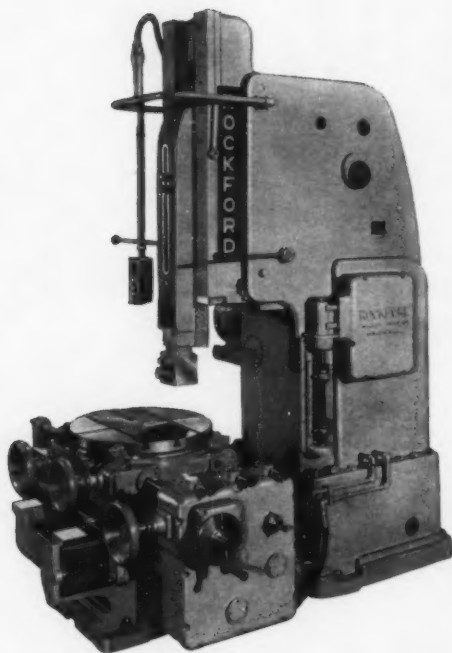
MACHINES DESIGNED TO MEET YOUR NEEDS ROCKFORD, ILLINOIS, U.S.A.

Hydraulic drive and feeds, as basic features of Rockford Hydraulic Machine Tools, provide outstanding performance measured in terms of work quality, high production and low operating cost. They also provide the cushioning action essential to the use of modern carbide tools.

do you get these advantages!

Today, countless metal-cutting operations are performed effortlessly, at low cost, and with high production rates on Rockford Hy-Draulic designed machines. Hydraulic control and power respond instantly so that inexperienced operators easily adapt infinite speeds and feeds to the most complex and accurate machining cuts.

Compare your present shaping, planing or slotting operations with these modern production features, and determine the savings available with Hy-Draulic flexibility. Our engineers will gladly furnish estimates for your particular requirements.



Rockford Hy-Draulic KOPY-KAT duplicator transfers single or 2-dimensional forms directly to the work on Rockford Hy-Draulic Shapers, Planers and Slotters. The hydraulic duplicator valve is so sensitive, so exact, that positive duplication of complex forms is completed with the ease of straight production machining.



ROCKFORD MACHINE TOOL CO.
2500 KISHWAUKEE STREET ROCKFORD, ILLINOIS

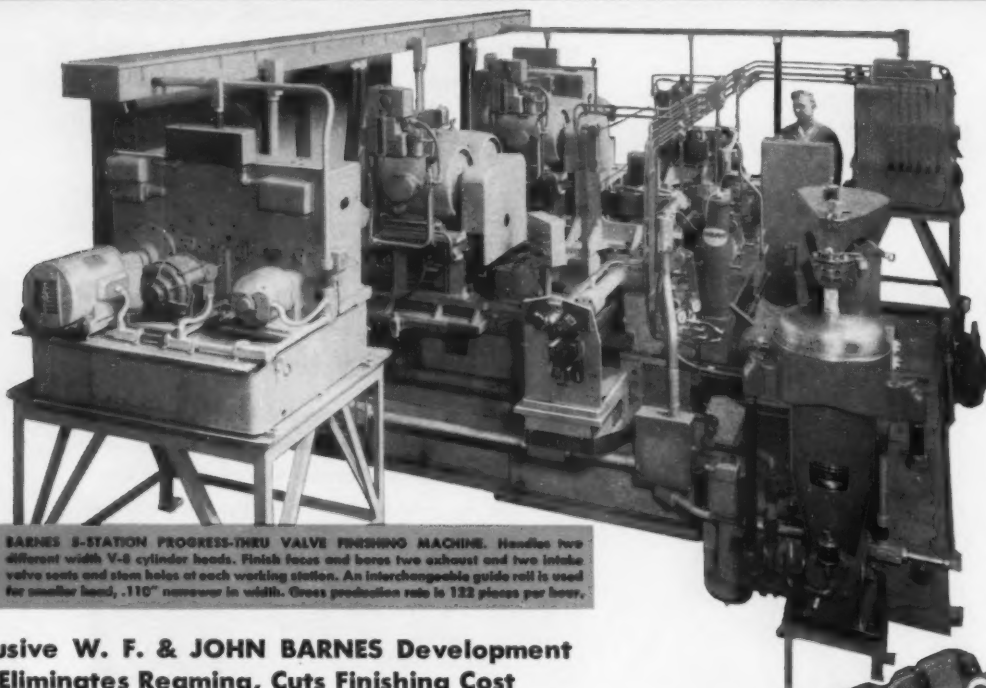
Machinery, January, 1960

FOR PRODUCTION MACHINE TOOLS IT'S

ROCKFORD, ILLINOIS, U.S.A.



FINISH-MACHINES VALVE SEAT and STEM HOLES in Single Pass



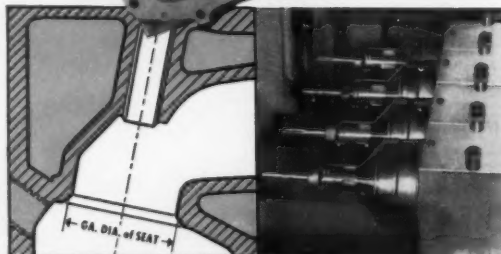
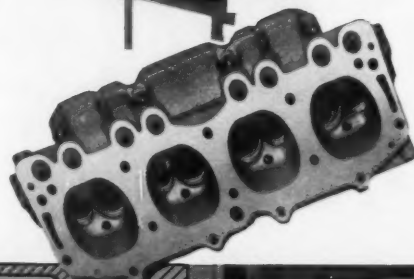
BARNES 8-STATION PROGRESS-THRU VALVE FINISHING MACHINE. Handles two different width V-8 cylinder heads. Finish faces and bores two exhaust and two intake valve seats and stem holes at each working station. An interchangeable guide roll is used for smaller head, .110" narrower in width. Gross production rate is 122 pieces per hour.

Exclusive W. F. & JOHN BARNES Development Eliminates Reaming, Cuts Finishing Cost

More and more manufacturers of internal combustion engines are today profitably using W. F. and John Barnes machines to cut costs in processing valve seats and stem holes. The accuracy of this new, exclusive tooling method reduces machining costs by eliminating the need for reaming or other final finishing operations. Guide holes are finish-bored and valve seats finish-faced simultaneously in a single pass. Concentricity of the valve stem hole and face is held within .0005" total indicator reading.

Basic Method Can Be Easily Applied To Either Small or Large Jobs

The efficiency of this new machining method can now be economically applied to all types of valve jobs — small as well as large cylinder heads or blocks. Either fully automatic or semi-automatic machines can be provided to suit your production needs. As illustrated, single machines can also be designed to efficiently handle more than one size workpiece which effects additional savings in floor space and equipment costs.



CONCENTRICITY .0005" T.I.R.
Fine finish to precision tolerances eliminates reaming operations. Concentricity of guide hole and gauge diameter of seat is held to .0005" T.I.R.

DUAL-TYPE PRECISION SPINDLES
Dual-type precision spindles equipped with facing and gun boring tools. A second 4-spindle head on machine above completes valve operations on V-8 cylinder heads.

Builders of Better Machines
Since 1872



ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — Ask a Barnes engineer to work with you when planning new or improved machining methods. His experience with, and knowledge of, proven cost-cutting methods can help you save time and money. Write for New Catalog illustrating how Barnes 6-point machine building service saves you time, and eliminates divided responsibility.

W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines



Machinery, January, 1960

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**



Deeper...Faster...Better

General purpose drills are designed for duty under ordinary, favorable working conditions.

But for deep hole drilling, or drilling in tough and abrasive materials such as this stainless steel, HEAVY DUTY drills should out-perform even good general purpose drills. They'll give more, better holes, faster and cheaper.

Heavier web, special surface treatment and split (easy starting) 135° point give good results where a general purpose drill might fail.

There is a best drill for every purpose. GREENFIELD-AMPCO makes them. Your "AMPCO Man" will be glad to talk over your drilling needs.



GREENFIELD TAP & DIE GREENFIELD, MASSACHUSETTS



HOLD IT WITH A HORTON

Round, square, hexagonal, or what shape have you. HORTON Independent Chucks with reversible jaws will hold it with a four jaw grip that's positive, true and reliable. A precision chuck for precision machining.

Capacities from 4 inches to 36 inches, in all standard mountings. Special chucks to 66".

HORTON, to be sure To be sure, HORTON

GEOMETRIC-HORTON NEW HAVEN 15, CONNECTICUT



*For top
efficiency in
tank cleaning*

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS



First choice in heavy-duty tank cleaning —hard-working Oakite "24"

Users everywhere agree that their best way to clean iron and steel parts is to tank-soak them in a hot solution of heavy-duty Oakite 24. This hard-working alkaline cleaner gets under the dirt layers and literally tears the soil from the surface. Despite excessive soil contamination of solution Oakite 24 maintains proper pH level and provides long, effective cleaning action.

Oakite 24 is but one of a wide range of alkaline tank-cleaning compounds. Others include medium and light duty oil and grease removers; self-emulsifying solvent cleaners specially designed for removing buffing compound residues, pigmented drawing compounds and other tenacious burned-on solid-particle dirt and smuts. Also available is a useful selection of materials for cleaning brass, copper, aluminum, magnesium, lead, tin and zinc.

Which is best for you? Only you and the Oakite

man together can decide. It depends on your equipment, the parts you process, the next production step. Ask the Oakite man. From over 30 materials, you're *sure* to get the one cleaner that works most efficiently for you. Write for Bulletins. Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite



BAUSH "SPECIAL" 3-WAY UNIT

DRILLS, ROUGHS, AND FINISH FORMS
SPARK PLUG HOLES IN CYLINDER HEAD —

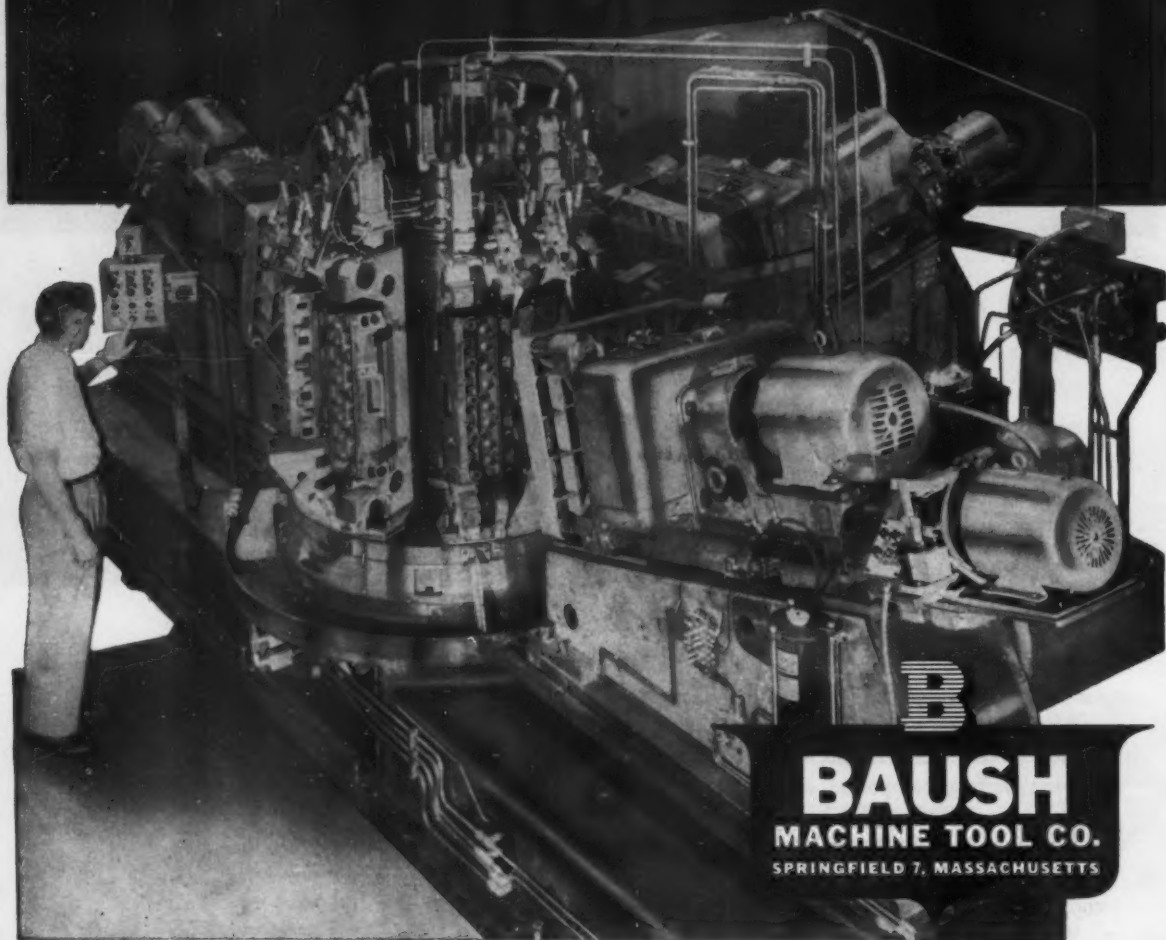
It is one of several different machines we have designed and are producing to complete a cylinder-head production line for a leading automotive manufacturer . . . resulting from past proven performance of other Baush units designed for specific jobs in this plant.

If you are thinking of AUTOMATION — THINK OF BAUSH. Our experience is yours — we'll gladly help with your machine tool problems.

SPECIFICATIONS:

Unit has 50" diameter, 4-station semi-automatic rotary table with a 2-position, 4-station fixture, plus full Trabon Lubrication. Three (3) 35° Vertical Angular Model "S" Mechanical Leadscrew units, each having a 4-spindle fixed center head, are mounted on a welded steel center base. Chip conveyor runs through machine.

Part is manually loaded into fixture and hydraulically located and clamped. Fixtures are equipped with guide bushing for tools and bars register in holding units when part is in machining position.



BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS

NEW from DELTA



20" metal-wood variable speed BAND SAW

No matter what your cutting requirements—in the foundry, toolroom or pattern shop—this all-new Delta 20" Metal-Wood Band Saw gives you real on-the-job performance. Now—for less than \$900.00—you can have the features you said you wanted most for greater accuracy and better cutting:

WIDE RANGE VARIABLE SPEED DRIVE . . . gives you a tremendous speed range—50 to 4500 FPM—for cutting everything from stainless steel to aluminum, wood and plastics. This versatility can't be equalled.

SCIENTIFICALLY DESIGNED BLADE GUIDES . . . ideal for heavy metal cutting because they furnish more "close up" blade support than conventional type guides. These new Delta blade guides are the key to better accuracy, straighter cuts, and longer blade life.

RUGGED FRAME CONSTRUCTION . . . features a massive, rigid internal frame with a modern fabricated exterior. Exclusive 3-point adjustability (wheels, upper guide and table) assures perfect alignment of key components.

In addition to these outstanding features you get a massive table with double trunnion support, convenient speed controls, plus built in chip blower *at no extra cost.*

SEE IT AT YOUR NEAREST DELTA DEALER— he's listed under "TOOLS" in the Yellow Pages—or write: Rockwell Manufacturing Company, Delta Power Tool Division, 614A, N. Lexington Avenue, Pittsburgh 8, Pa.



BLADE WELDER, including shear and grinder, shown on No. 28-462 Bracket mounted on 20" Band Saw for machine-side use. (Optional accessories)

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL





Here's the quick, low-cost way to get any Controlled Surface Finish

Are you paying more than necessary to obtain *controlled surface finishes*? You probably are if Gisholt Superfinishing is new to you. You are losing time, money and paying a premium for quality as well, on many jobs.

With Superfinish you preselect the surface finish you need—as high as 80 or as low as 1 micro-inch RMS—and you get it faster, at less cost than by any other method. Rather than an expensive extra step, Gisholt Superfinishing actually eliminates tedious, more costly processes.

Not only do you save time and money, but you get a "controlled" surface finish, free of smear metal—with the true base metal exposed—one that provides greater area contact for heavier loads and longer life in your specific application.

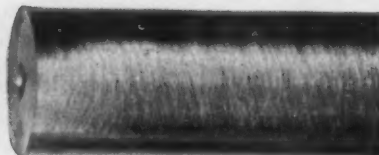
Whether your job requires a 1, 20 or 80 micro-inch finish, setup is fast and easy. Nothing is left to the operator's skill or judgment. Stone pressure and grade, and reciprocation rate are preselected to produce the finish you require, for job lots or large production runs.

It will pay you to find out how Gisholt Superfinish can cut costs, improve quality and lengthen service life on your standard or problem parts. Ask your Gisholt Representative or write for Bulletin 1169.

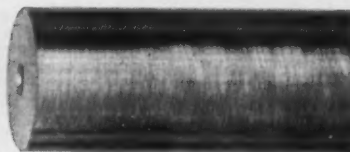
60
Micro-Inches
RMS



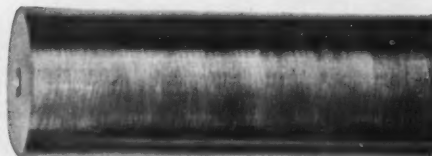
45
Micro-Inches
RMS



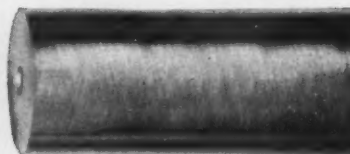
30
Micro-Inches
RMS



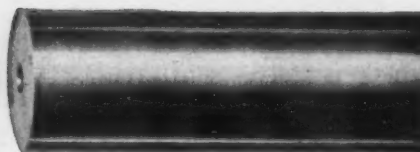
20
Micro-Inches
RMS



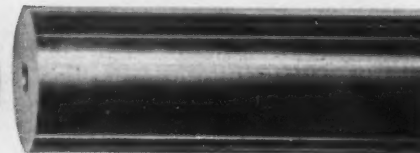
15
Micro-Inches
RMS



10
Micro-Inches
RMS



5
Micro-Inches
RMS



1
Micro-Inch
RMS



GISHOLT

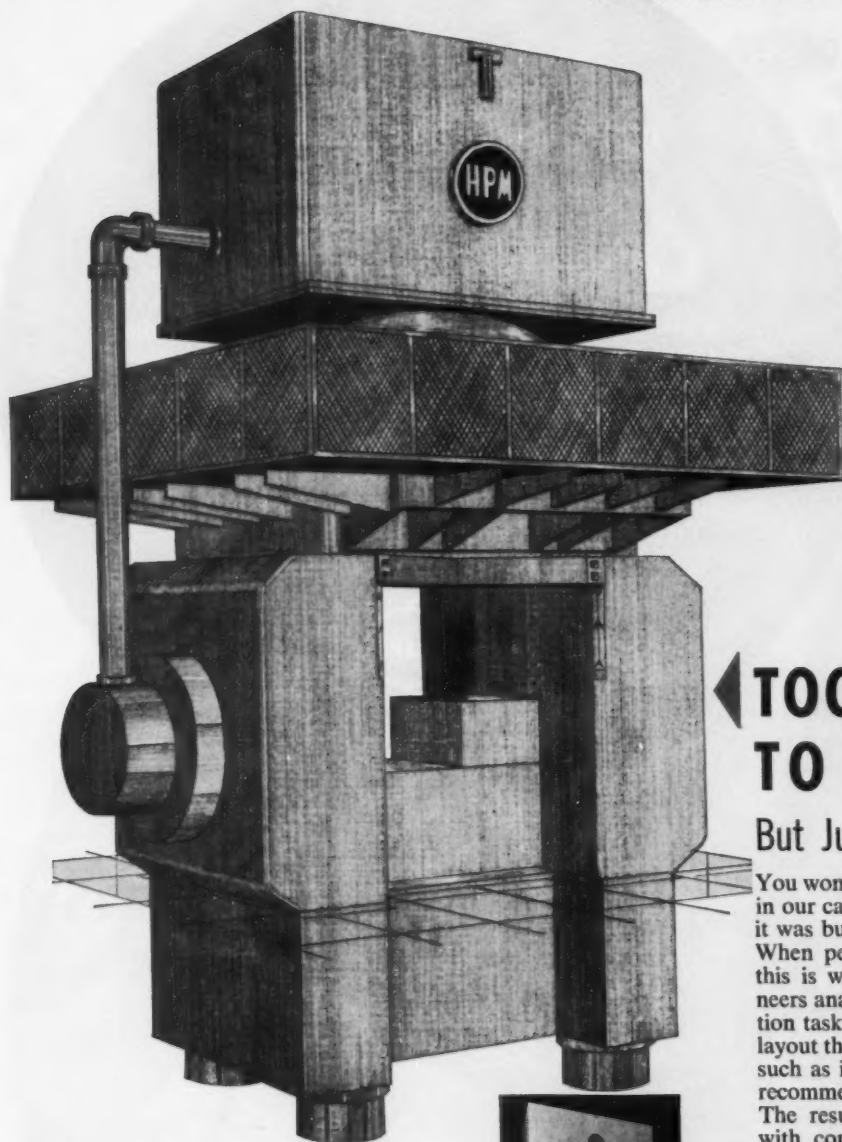
MACHINE COMPANY

Madison 10, Wisconsin

Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Lathes • Factory-Rebuilt Machines with New-Machine Guarantee

Investigate Gisholt's Extended
Payment and Leasing Plans

HOW MODIFIED H-P-M STANDARDS TRIPLE
THE USEFULNESS OF METALWORKING PRESSES



From original design sketch to finished press, at right, H-P-M engineers apply the experience gained from literally hundreds of other "modified" standards. This press was expressly designed for high speed production of bar shapes, in refractory metals, carbides, etc. Force is infinitely variable up to 3000-tons downward with 1500-tons side action. A smaller internal ram provides separate action with over twice the speed for work less than 1200-tons.



TOO CUSTOM TO CATALOG

But Just Right For The Job

You won't find this 3000-ton H-P-M press in our catalog, but it fits the job for which it was built . . . *like a glove*. It's a typical. When people bring problems to H-P-M, this is what happens: Experienced engineers analyze every phase of your production task, establish the physical needs and layout the basic requirements in a machine such as illustrated. Standard elements are recommended in the majority of cases. The result — a standard press, modified with control and power essentials to fit your range of products exactly. *Special*, as required to handle your production problem with greatest efficiency; *standard*, to the extent that minimum engineering is required due to the hundreds of presses designed in the past for special requirements.

You're under no obligation if you ask the "why and how" of this specialized service. Write or call for complete details. See how better quality production can be planned more efficiently, at lower costs.

THE HYDRAULIC PRESS MANUFACTURING COMPANY
A Division of Koehring Company • Mount Gilead, Ohio, U.S.A.



H70

At Raytheon Mfg. Co. . . .

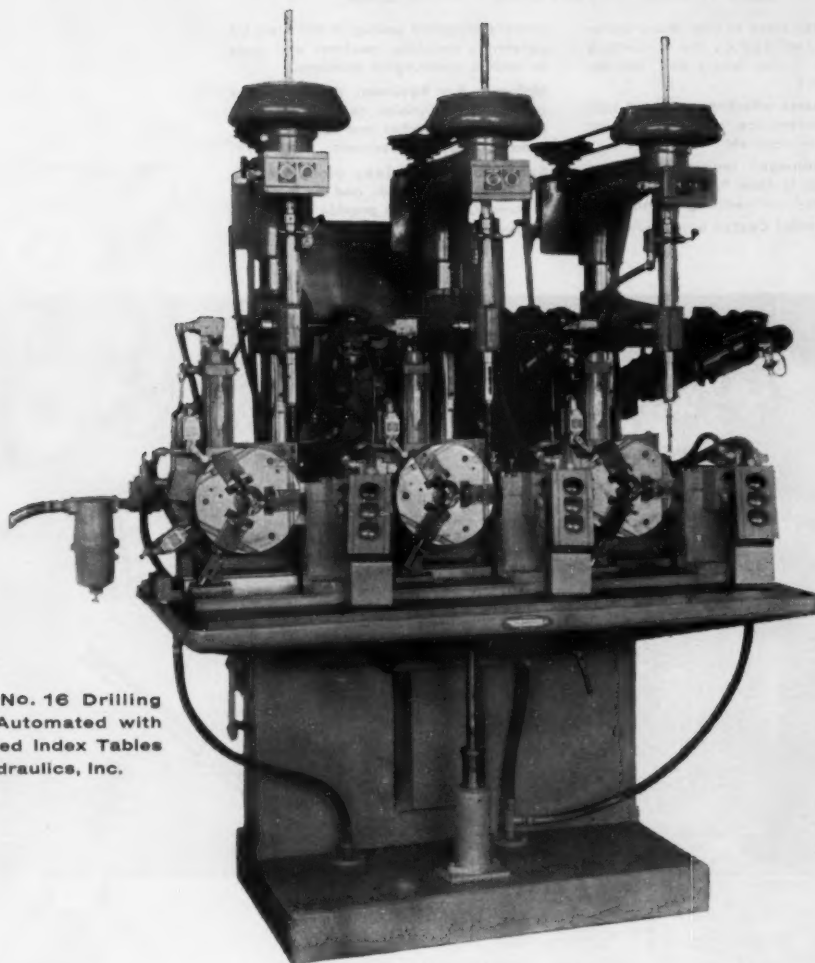
Grinding non-ferrous materials to fine tolerances!



This leading manufacturer of electronic systems uses new hard ceramics as microwave system components. These extremely tough materials presented a difficult grinding problem. It was solved by using diamond abrasive wheels on Blanchard No. 11 grinders. The results were outstanding. Disks measuring approximately $2\frac{1}{4} \times \frac{1}{4}$ " were ground to a tolerance of $\pm .001$ ", with $\frac{1}{8}$ " of material removed. Flatness is .002", parallelism .002". These parts are ground at the rate of 48 per hour, and surface finish is consistently excellent.

Write for your copy of "Work Done on the Blanchard".
THE BLANCHARD MACHINE COMPANY
64 State Street, Cambridge 39, Mass., U. S. A.





"Buffalo" No. 16 Drilling Machine Automated with Air-Operated Index Tables by Air Hydraulics, Inc.

8 YEARS OF SATISFACTION MADE THIS SALE!

Nothing sells a product like customer satisfaction. Here's proof:

Eight years ago a large mid-western manufacturer bought a "Buffalo" No. 16 Drilling Machine. It proved to be an excellent production machine. Quantity and quality of output were high. The No. 16 stood up to the punishment of continuous production with a minimum of maintenance.

This year the manufacturer decided to automate certain drilling and reaming operations. Because of eight years of complete satisfaction, a new 3 spindle "Buffalo" No. 16 Drilling Machine was specified.

The mechanism for automating the "Buffalo" Drill was designed and built by Air-Hydraulics, Inc. of Jackson, Michigan. Air-Hydraulics used its Model "H", 10" dia. Air-

Operated Index Tables. The automated operation was drilling and reaming three lug-holes on the work piece.

The production rate was originally estimated at 150 pieces per hour. Air-Hydraulics reports that the actual production rate is 215 pieces per hour.

Here's a case of "three-way" satisfaction, with "Buffalo" Drills. Both the manufacturer and Air-Hydraulics are satisfied. And we are happy that our customer's satisfaction dictated the choice of a new "Buffalo" No. 16 Drilling Machine for this automation job.

For this kind of complete satisfaction, why don't *you* specify "Buffalo" Drills? Contact your "Buffalo" machine tool dealer, or write us direct for full information.



BUFFALO FORGE COMPANY

440 Broadway Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING • PUNCHING • SHEARING • BENDING

MACHINERY, January, 1960

For more data circle this page number on card at back of book

**NATIONAL ACME'S "ZONE OF RESPONSIBILITY"
INCLUDES ALL PHASES OF COST REDUCTION**

Check YOURS . . . Then Check National Acme

Direct Costs: these include direct dollar savings as realized by the McCulloch Corporation . . . an "every day" job for Acme-Gridleys.

Indirect Costs: effecting important savings in maintenance, downtime, scrap reduction, tool costs, etc.

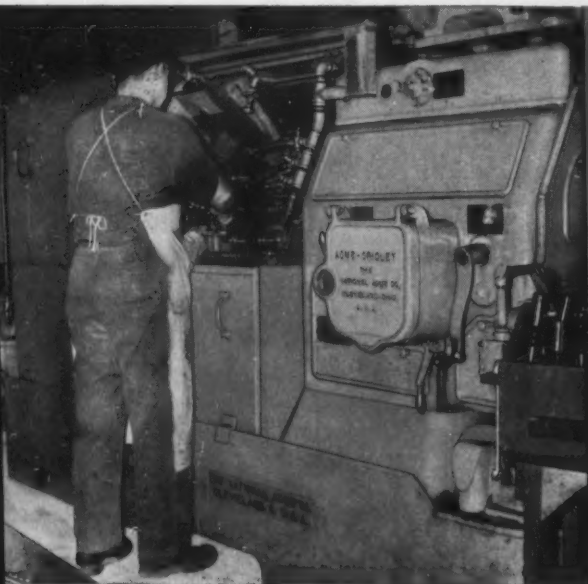
Product Redesign: teaming with your design group to take full advantage of Acme-Gridleys' cost reducing capabilities.

Direct Material Costs: our engineers

provide important savings in this area by constantly matching machines and tools to modern metallurgical problems.

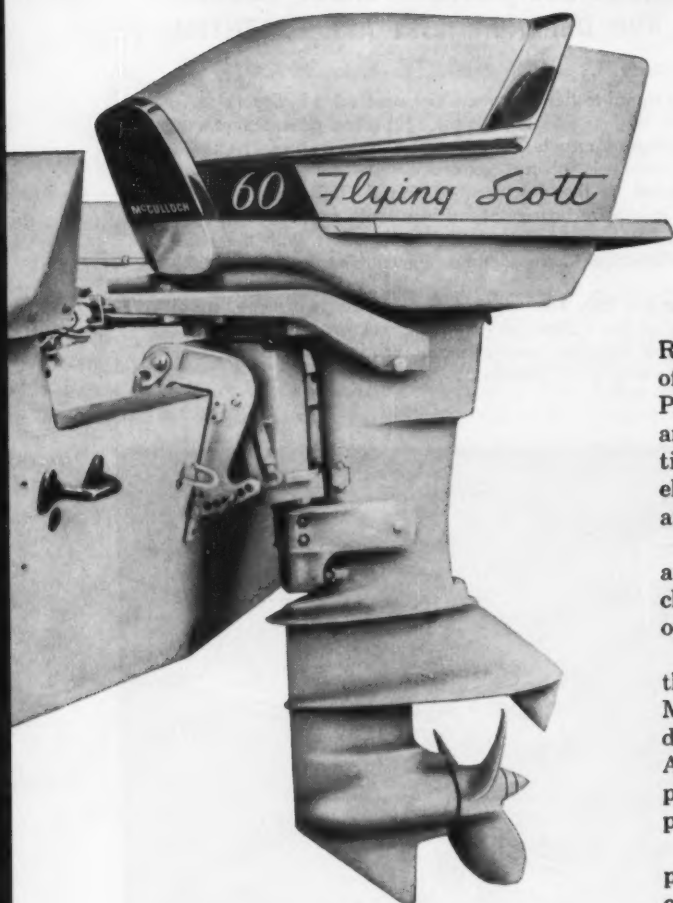
Make-or-Buy Reviews: in many cases our Contract Division can assume your production headaches and relieve you of immediate capital investment.

Spot Modernization: pioneering in modern tooling methods, and the flexibility of Acme-Gridleys can provide many "on-the-spot" savings.



McCULLOCH CORPORATION LOGS 66% COST REDUCTION

...with Acme-Gridleys



Reduced cost-per-piece of tilt-lock knobs was but one of the enviable savings made possible for the Marine Products Division of the McCulloch Corporation by an Acme-Gridley RA-6 Spindle Automatic. In addition, McCulloch boosted output 200%, practically eliminated scrap losses, and greatly improved finish and final appearance of this small but critical part.

Previous production methods required one primary and two secondary operations. Now, complete machining—including deburring, is done in one automatic operation on the Acme-Gridley.

Dramatic savings in the production of parts like this make Acme-Gridleys a vital, cost-saving cog in McCulloch's highly efficient production set-up. Evidence of this leading manufacturer's high regard for Acme-Gridley efficiency is the fact that 14 different parts for their popular 60HP "Flying Scott" are produced on the rugged, versatile RA-6 Automatic.

It will pay you to thoroughly study the savings possible with Acme-Gridleys. Call, write or wire for complete details on industry's most modern approach to tangible cost reduction.

Pioneer in
Circumferential
Automation



National Acme

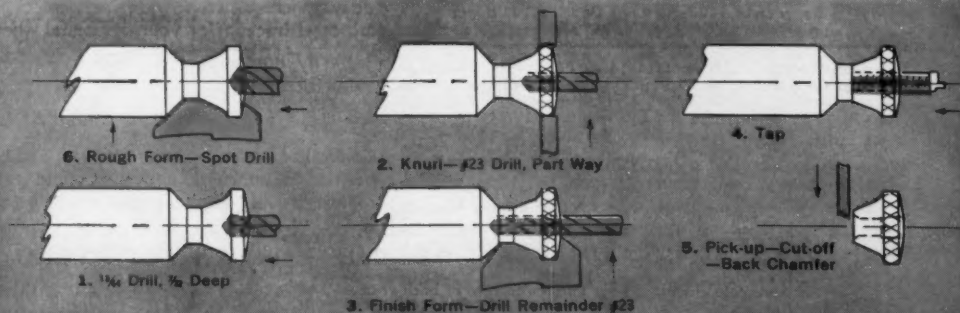
The National
Acme Company
17th E 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

10 Operations



in 5 Seconds



an improved
VICKERS.
SERVO VALVE

...yet priced
 20% below
 previous models

**FOR PRECISE CONTROL OF OIL FLOW
 IN INDUSTRIAL, MILITARY AND MARINE
 HYDRAULIC SYSTEMS WHERE HIGH
 RESPONSE, ACCURACY, SIMPLICITY, RUGGED-
 NESS AND DEPENDABILITY ARE ESSENTIAL**

Input signal to this improved Vickers electro-hydraulic servo valve can originate from a simple calibrated potentiometer or a sophisticated magnetic or punched tape reader system—yet the result is always extremely precise hydraulic flow proportional to the electrical command. This valve can be applied to a broad array of machine tools, process equipment and ordnance applications and is compatible with the wide range of command input methods commercially available.

There are only four moving parts in the two-stage, spool assembly of the Vickers servo valves, thus providing a simple, contaminant tolerant, exceptionally reliable operation. Get details by writing for Bulletin 59-74.



Available in models for flows to 37 gpm and suitable for operation at pressures to 3000 psi with a choice of mountings.

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
 Department 1403 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO AREA (Bensenville)*
 CINCINNATI • CLEVELAND • DETROIT* • GRAND RAPIDS • HOUSTON
 INDIANAPOLIS • LOS ANGELES AREA (El Segundo) • MILWAUKEE
 NEW YORK AREA (Springfield, N.J.)* • PHILADELPHIA AREA (Media)
 PITTSBURGH AREA (Mt. Lebanon) • ROCHESTER • ROCKFORD • SAN
 FRANCISCO AREA (Berkeley) • SEATTLE • ST. LOUIS • WORCESTER
 Factories also in: Australia, England, Japan and Germany
 In Canada: Vickers-Sperry of Canada, Ltd., Toronto,* Montreal and Vancouver
 Field Service Headquarters Underlined. Whse. Stock & Repair Branches*.

**WHAT VICKERS' "BUILDING BLOCK"
 CONCEPT MEANS TO YOU**

These pre-engineered electro-hydraulic servo systems offer positional accuracies of $\pm .0015$ -inch; and down to $\pm .0005$ -inch using the same standard components but with additional "trim." Your cost for Vickers "Building Block" systems is far below that normally associated with this degree of accuracy and response. These systems are specifically designed for heavy duty, industrial use.

Plug-in elements make trouble shooting and maintenance easy. Vickers' worldwide service organization insures unmatched backup for your personnel when required.

Why not contact the Vickers office near you today for more facts?

TYPICAL APPLICATIONS

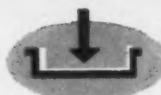
Controlling velocity in processing applications • controlling position of machine tool slides and tables • programmed control of work handling and machine sequencing.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

WHATEVER YOU WANT A PRESS TO DO...



BLANK



FORM



DRAW



COIN



EXTRUDE

THERE'S A BLISS PRESS TO DO THE JOB BETTER!

Bliss makes more types and sizes of presses than any other builder

No matter how big or how complex that next metal stamping job may be, it makes sense to call on Bliss. Size never has presented any problem to us, and complexity is our specialty. And because Bliss makes more types and more sizes of presses than any other builder in the business, you're sure to get impartial counsel—sure that your trained Bliss representative will "grind no axe" for any one type of press. And remember this: he's backed by more than a century of experience in building presses of all types, all sizes, for all kinds of industry.



*BLISS is more than a name
it's a guarantee*

E. W. BLISS COMPANY, Canton, Ohio

PRESSES • ROLLING MILLS • ROLLS • DIE SETS
CONTAINER MACHINERY • CONTRACT MFG.



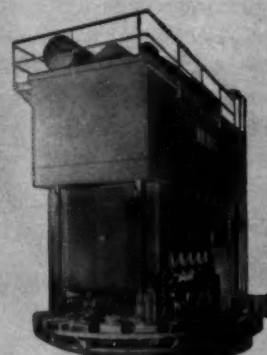
INCLINABLE PRESSES... in bench, single or double crank, modern enclosed design. With air friction or mechanical clutches, and whatever you need in cushions and feeds.



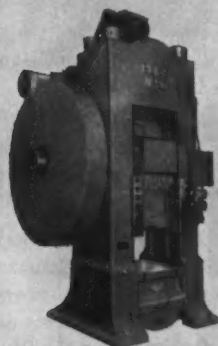
STRAIGHT SIDE PRESSES... eccentric and crankshaft models... any size... modern enclosed design, with whatever automatic features you want.



HIGH PRODUCTION PRESSES... specially designed for continuous high speed automatic operation. Up to 1000 spm. Available in a variety of sizes... and precision feeds.



TRANSFER FEED PRESSES... for the ultimate in production. Bliss pioneered the development, now builds them for blank or coil stock work, with no limit on size.



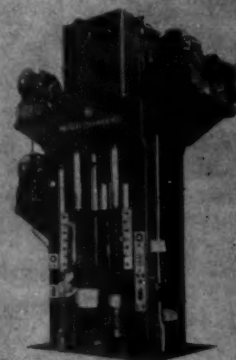
KNUCKLE JOINT PRESSES... for slow, powerful application of pressure at near-bottom stroke. Bliss builds them from 75 to 10,000 tons capacity in 40 standard models for coining, embossing, extruding, sizing and swaging.



FORGING PRESSES... for production of turbine blades, crankshafts—hot forging, cold coining and other operations. Built in a number of sizes, from 300 to 4000 tons capacity, to standard and special design.

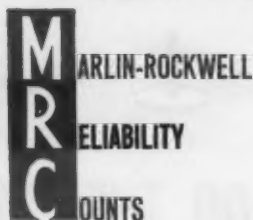


TOGGLE PRESSES... Double and triple action designs with quick advance and return speed features; modern electronic controls and automatic lubricating systems. From giant "automotive" sizes to compact units for small parts.



HYDRO-DYNAMIC® PRESSES... single action or double open rod construction or closed, 20 tons capacity to 35,000 or even more, standard design or special high speed models, electronic controls—Bliss has built them all.

IN PILLOW BLOCKS, FLANGE and FLANGETTE UNITS



Pillow Blocks & Flange Units

with MRC **Labri-Seal®**
Ball Bearings

MRC Pillow Blocks and Flange Units combine smooth contour and compact design with rugged strength. They are equipped with MRC Labri-Seal Ball Bearings.

The Labri-Seals combine the advantages of a rotating flinger, labyrinth seal and positive contact synthetic rubber seal.

The bearings are lubricated with a high quality, long life grease at assembly — eliminating necessity of further lubrication — resulting in longer life and savings in maintenance cost.

MRC LABRI-SEAL Ball Bearings keep out dirt and moisture and retain the bearing lubricant.

Their efficiency is proven in thousands of successful applications.



MRC
Pillow Blocks

MRC
Flange
Units

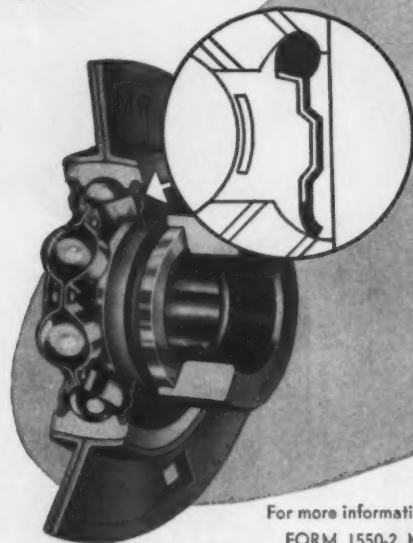
Flangettes

with MRC **Synthe-Seal®** Ball Bearings

The MRC Flangette design provides a high quality — easily installed unit with a versatile mounting arrangement for agricultural and industrial applications.

MRC Flangette Units are complete with MRC Synthe-Seal Ball Bearings with locking collar.

MRC Synthe-Seal Ball Bearings have a long history of successful operation in thousands of applications including extreme conditions of dirt and moisture and where leakage of lubricant might damage products being processed.



MRC
Flangette Units

For more information write or phone for:

FORM 1550-2 MRC BALL BEARING PILLOW BLOCKS
AND FLANGE UNITS

FORM 1547-2 MRC POWER TRANSMISSION BALL BEARINGS
FORM 1528-13 MRC SYNTHE-SEAL® BALL BEARINGS
ENGINEERING NO. 7-17 FLANGETTES

Marlin-Rockwell Corporation
Jamestown, N. Y.



FOR JOBS LIKE THIS — FOR JOBS LIKE YOURS

EX-CELL-O BUILDS VERSATILITY INTO A FULL LINE OF PRECISION THREAD GRINDERS



Above:

The Style 36 Precision Thread Grinder used to grind the worm gear shown above is equipped with a standard Three-Way, Cradle-Type Diamond Dresser.

Below:

Huge worm gear, shown during finish grinding, has 10" diameter. Depth of cut is $1\frac{1}{4}$ ", with .170" stock removal. Thread form has included angle of 29°, a triple lead of 6", and a specified pitch diameter of 8.0763".



A job as tough as grinding this hardened steel worm gear used by a milling machine manufacturer may not be every-day work for an Ex-Cell-O Style 36 Precision Thread Grinder—but it can be!

Ex-Cell-O Precision Thread Grinders combine toolroom accuracy with production output. Inbuilt flexibility makes them ideally suited to a wide range of workpiece shapes and sizes, and the popular Styles 36, 50 and 120 can be optionally equipped for precision grinding of internal threads.

Whatever the thread type—single or multiple, right or left-hand, straight or radius forms—there's an Ex-Cell-O O.D., I.D. or universal Precision Thread Grinder with

the right capacity, the preferred automatic features, the proper wheel dresser and the versatility to suit nearly every need. Write direct for the descriptive catalog, or call your local Ex-Cell-O Representative.

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

XLO
EX-CELL-O FOR PRECISION
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

WHY RED RING GEAR SHAVING CUTTERS DO SUCH AN EXCEPTIONAL JOB



- Here are some of the reasons for the accuracy, for the job performance and the long economical service life of Red Ring Shaving Cutters.
- These cutters are engineered and produced by skilled specialists who have, for the past 27 years, devoted full time to shaving cutters, exclusively. Never underestimate this vast fund of experience which is unmatched anywhere else in the field.
- All Red Ring cutter grinding and cutter inspections are carried on in temperature controlled departments, for maximum precision. Where else is this done?
- Every Red Ring Cutter is made from a controlled specification forging—proper grain flow and uniform distribution of carbides in the tooth zone.
- Every Red Ring Cutter is heat treated in Red Ring furnaces under the direct control of Red Ring metallurgists.
- Every new cutter design is given a thorough performance try out in the Red Ring Gear Laboratory before it is released.
- Red Ring cutter engineers and service specialists are always available for consultation and to help a cutter customer in an emergency.

When you buy cutters, take advantage of these extra benefits. There is no extra cost.



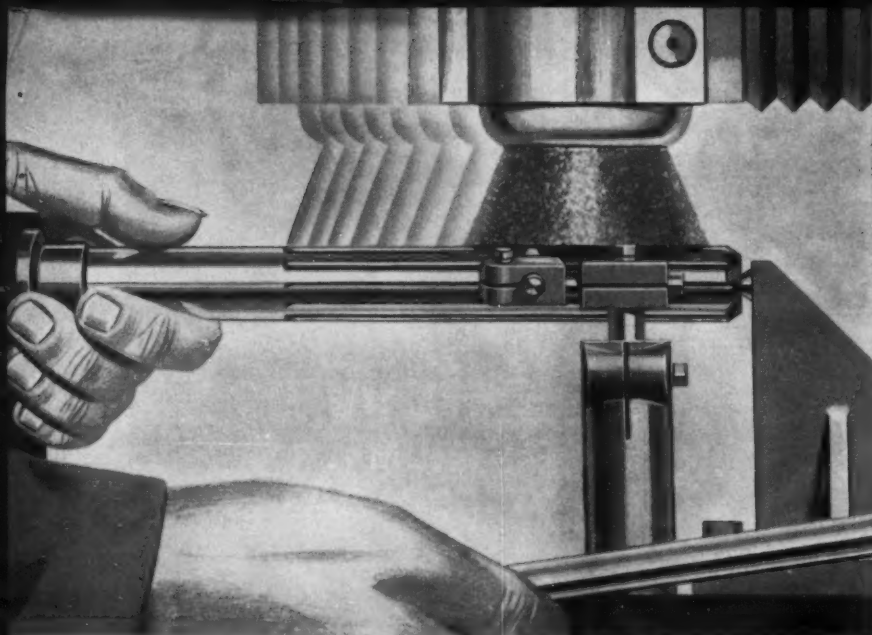
SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

8263

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT



OLIVER "ACE" TOOL AND CUTTER GRINDER

Traverses the wheel—not the work!

You can grind tools and cutters more accurately with the Oliver "ACE" because the wheel is brought to the work, reversing the usual process. Abrasive dirt and grit cannot cause wear because the cross carriage is not in motion. The horizontal ram which supports the grinding head is fully enclosed—sealed against dust and dirt. Further accuracy is assured because the wheel is trued by a stationary diamond which provides a fixed grinding line. It is not necessary to reset the cutter to compensate for wheel wear.

The "ACE" is a tool and cutter grinder designed expressly for tool grinding—not a general purpose machine adapted to tool room work. It is simple to set up. All angles are obtained by direct reading. Operators stand in a natural position with the control lever in easy reach and the work in direct view.



Face mills, reamers, end mills, staggered tooth cutters, slab mills, spot facers—all cutters straight or spiral—are quickly, easily and economically sharpened with the Oliver "ACE". Both standard and heavy duty models are extensively used for sharpening carbide-tipped circular wood saws used in both wood-working and metalworking.

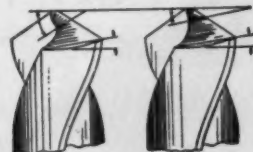
Write today for complete information. We'd appreciate the opportunity of sending a quotation.

OLIVER of ADRIAN
1410 E. Maumee St. • Adrian, Michigan

DRILL GRINDERS AND THINNERS—TOOL AND CUTTER GRINDERS—AUTOMATIC AND MANUAL
FACE MILL GRINDERS—TOOL BIT GRINDERS—CONTOUR SAWING AND FILING MACHINES

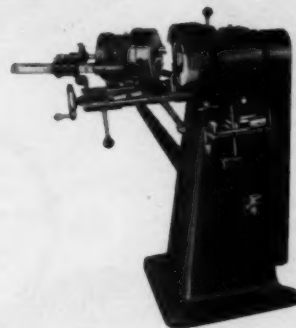
HOW TO REDUCE YOUR TWIST DRILL COSTS

Any substantial reduction in drill costs must be made by choosing a combination of the right drill design and drill point.



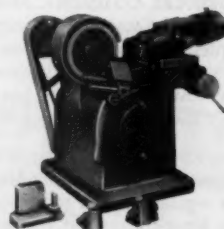
The sketch above shows a comparison of two drill points. The one on the right is as ordinarily ground. On the left is an exaggerated view of an Oliver drill point. Note that the clearance angle on the point increases very rapidly as the drill web is approached.

It is a widely accepted fact that for a given feed the angle of helix of the feed is greater as it approaches the center. It is this reason that makes increased clearance at the center of the drill point so essential. The Oliver pointers provide average thrust reductions of 25.2% and average torque reductions of 22.0%.



The Oliver 510 makes possible the trouble free grinding of drills—whether 2, 3 or 4 flute. Variable included point angles and clearances are easily obtained.

This cost-saving point is also available by using the new heavy-duty #21 bench model machine. Capacity is



3/32" to 1/2". A 5" diameter cup wheel and a built-in diamond dresser provides for easy operation regardless of drill size or included angle.

Cu
97.50%

Ni
1.90%

Si
0.60%

NEW
FROM
ANACONDA

Announcing
CUNISIL-837

a versatile high-strength, heat-treatable
copper alloy with this valuable
combination of properties

**HIGH
TENSILE STRENGTH**

90,000 psi min., in
precipitation-hardened
condition.

**HIGH
YIELD STRENGTH**

70,000 psi @ .50%
extension under load,
min., in precipitation-
hardened condition.
Elongation in
4 x D, min., 8%.

**HIGH ELECTRICAL
CONDUCTIVITY**

30 to 42% IACS
as heat treated.

**EXCELLENT
COLD FORMING**

Extremely easy to work
cold before hardening
heat treatment.

**READY
MACHINABILITY**

Compared with Free
Cutting Brass Rod at 100,
its machinability
rating is
approximately 40.

**HIGH CORROSION
RESISTANCE**

Comparable to copper
and Everdur copper-
silicon alloys.

**AVAILABLE
AS ROUND ROD**

In straight lengths
including $\frac{1}{8}$ " dia.
to 1" dia. In coils
 $\frac{1}{8}$ " dia. to $\frac{1}{2}$ " dia.
Inquire for
other sizes.

METALLURGICAL COMMENT. Most of the nickel and silicon in heat-treated Cunisil are present as an intermetallic compound, nickel silicide, and it is the precipitation of nickel silicide in the form of particles of submicroscopic size by a relatively low temperature heat treatment that accounts largely for the distinctive properties of the alloy.

Prior to the hardening heat treatment, the alloy is brought to a proper condition for hardening by giving it a solution anneal at a much higher temperature and then a quenching from this temperature; at this stage the alloy is quite soft and in a condition for drastic cold-working operations. The hardening heat treatment consists of heating at a controlled temperature for a definite length of time to obtain the desired mechanical properties.

CUNISIL-837 is a high-strength, corrosion-resistant alloy that includes many of the desired qualities of Silicon Bronze or Everdur®. Its applications to date have been primarily in the electrical equipment field.

FOR MORE INFORMATION—see your American Brass representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

6047

ANACONDA®

Copper and Copper Alloy Mill Products
MADE BY THE AMERICAN BRASS COMPANY



Man-made diamonds add the newest "Touch of Gold" value to carbide grinding

In carbide grinding the product-improving, cost-cutting "Touch of Gold," created by Norton leadership in diamond wheel development, began back in 1930. Today, man-made diamonds are adding something new to the "Touch of Gold." Their use as abrasives is steadily increasing, because of their improved performance and economy.

Norton was first to introduce all three bond types of diamond wheels . . . manufactures with complete uniformity of specification . . . produces the largest line . . . and *certifies* the diamond content of each wheel. Today, similar pioneering continues Norton leadership in the use of man-made diamonds . . . bringing you better performance, longer service life and

lower grinding cost for every dollar you spend. NORTON COMPANY, Worcester 6, Massachusetts.

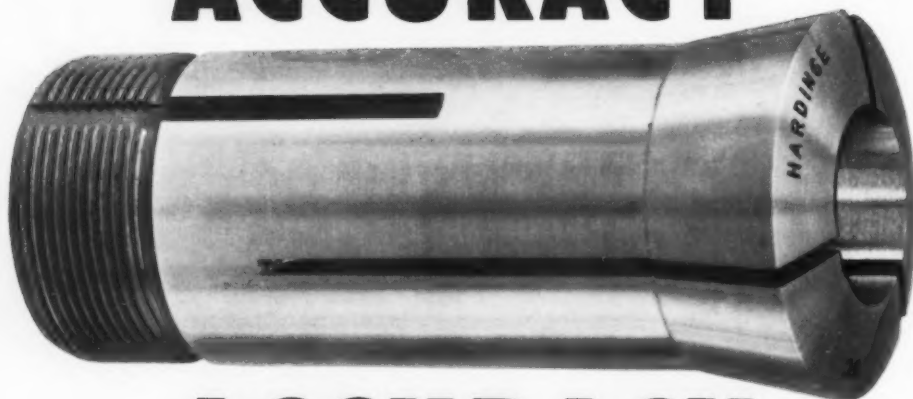


Making better products . . . to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — **DEHN-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

HARDINGE
ELMIRA, N.Y.

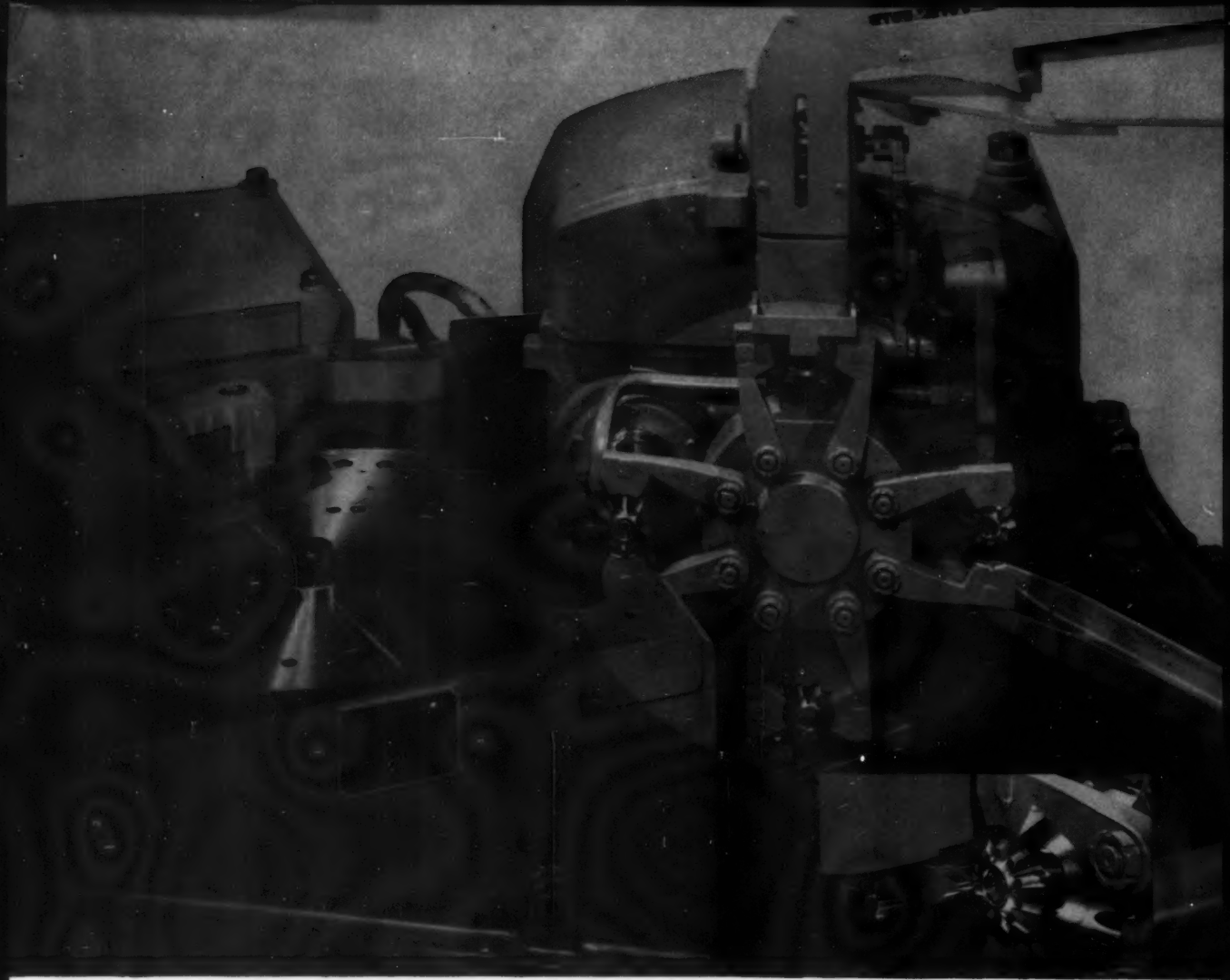
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*HARDINGE has specialized in the manufacture of collets since 1890.
HARDINGE today stocks collets in sixteen principal cities in the United States and Canada.
Ask for descriptive bulletins.*

HARDINGE BROTHERS, INC., ELMIRA, N. Y.
PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE



Fastest way yet to cut straight bevel gears

If you're looking for a faster, fully automatic way to cut straight bevel gears and pinions with conjugate surfaces and localized tooth bearings, consider the Gleason No. 109 Straight Bevel Revacycle® Machine.

You rough, semifinish, and finish a tooth from the solid blank with a single rotation of the Revacycle cutter.

Now both 21" and 25" diameter cutters can be used on the No. 109 Revacycle Machine. The 25" cutter cuts gears to a maximum depth of 0.600".

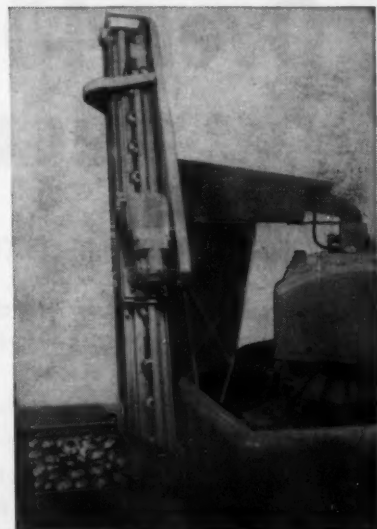
The 21" cutter will cut to a maximum of 0.400".

A new, completely automatic mechanism loads and unloads each gear. You can feed this loader manually or with a conventional belt conveyor.

The No. 109 Machine handles a wide range of automotive and farm machinery gears: up to 10" diameter, 5:1 ratio, 1¼" face width.

Send for our bulletin for information on both the machine and the Revacycle Method.

In Revacycle Method each blade of cutter is longer than its predecessor; there is no depth-wise feed of cutter itself. One rotation of the cutter completes each space from the solid.



Storage unit and flight conveyor can be fed manually or with belt conveyor. Even with manual operation, one operator can handle a battery of machines.



GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

Diluted cutting oil causes costly troubles in automatic screw machines... short tool life... frequent downtime. Diluted cutting oil can be cured... forever! Prove it yourself... Start the

Texaco Cleartex Cure

3 TO 5 Ounces of Cleartex Cure added to 100 to 200 Ounces of diluted cutting oil will give 100% of full automatic screw machine performance. This is because Cleartex Cure is a synthetic oil which is more resistant to heat and oxidation than ordinary cutting oil.

TOOL LIFE AND TOOL GRINDS. Cleartex Cure is a synthetic oil which is more resistant to heat and oxidation than ordinary cutting oil. It is also more resistant to wear and tear than ordinary cutting oil. This means that tools will last longer and will not need to be ground as often.

EXTENDING TOOL LIFE. Cleartex Cure is a synthetic oil which is more resistant to heat and oxidation than ordinary cutting oil. It is also more resistant to wear and tear than ordinary cutting oil. This means that tools will last longer and will not need to be ground as often.

A GENERAL PURPOSE. Cleartex Cure is a synthetic oil which is more resistant to heat and oxidation than ordinary cutting oil. It is also more resistant to wear and tear than ordinary cutting oil. This means that tools will last longer and will not need to be ground as often.

HERE'S HOW: First, call in a Texaco Lubrication Engineer. Let him survey your automatic set-up—include being checked, operating conditions, etc. Then, if your automatic screw machine has one of the most important that can benefit from the Texaco Cleartex Cure, use a Cleartex Cure for both cutting and lubricating. In just one machine as a test, for 10% of cost, make it see today, now in charge of production and maintenance costs. Let's see how Cleartex Cure can help you solve this one problem.

1959 TEST FOR DETAILS OF DETAILS

Over 400 automatic screw reduced costs in 1959

THIS IS WHAT WE PROMISED THE CLEARTEX CURE WOULD DO, JUST TWELVE MONTHS AGO:

- increase production by $\frac{1}{3}$ from 7 out of 10 automatics
- end wasteful dilution of cutting oil forever
- sharply reduce the number of rejects
- extend tool life—and reduce tool regrinds, tool replacements, and downtime.

Now—here's proof: In 1959, the more than 400 automatic screw machine plants mentioned put Cleartex Oil in on test. All are now regular Cleartex users—enjoying the extra production and cost savings we promised.

Why don't you get the benefits of the Cleartex Cure? Here's all you have to do: 1) Send for Texaco's free booklet which tells you how the Cleartex Cure works. 2) Ask Texaco to send one of its Metalworking Engineers to your plant. He'll survey your automatic set-up and tell you which machines will benefit from Cleartex Oils. He'll also, if you wish, set up a test on one machine to show you how the Cleartex Cure can save money. He'll even demonstrate the Cleartex Cure on an entire line of machines if you want immediate savings. For fast action,



CLEARTEX is a tri-purpose oil for automatic screw machines that acts as a cutting oil and a lubricant and, if necessary, as a hydraulic fluid as well. This Cleartex advertisement, printed last year, shows how Cleartex ends cutting oil dilution, extends tool life, reduces rejects.

machine plants by acting on this ad!

just mail the coupon. Texaco Inc., 135 East 42nd Street,
New York 17, N. Y.

Tune In: Texaco Huntley-Brinkley Report, Mon. Through Fri.-NBC-TV

TEXACO 
Throughout the United States
Canada • Latin America • West Africa

MACHINERY, January, 1960

TEXACO INC.
DEPT. MA-40
135 E. 42nd ST., NEW YORK 17, N. Y.

- ☐ Please send me your free descriptive booklet on the Cleartex Cure.
- ☐ Please ask a Texaco Metalworking Engineer to arrange for a survey on my plant.

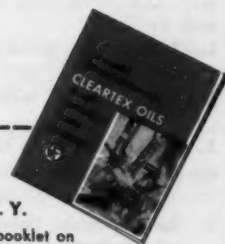
Name _____

Title _____

Company _____

Address _____

City _____ Zone _____ State _____



For more data circle this page number on card at back of book



HERE'S PROOF OF PERFORMANCE: "CLAUSING - BEST VERTICAL MILLER FOR SMALL PARTS MANUFACTURING"

"Any job within the capacity of the machine can be handled easier, and up to 50% faster, on a Clausing than on any other mill. And, its accuracy is not exceeded by mills costing more than twice the price - in fact, we use our Clausings for some of our jig bore work. You just can't beat it for small parts manufacturing."

Harold Meyers, Meyers Machine Co., Grand Rapids, Mich.

VERIFIED ACCURACY — Before it leaves the factory each CLAUSING MILL must pass rigid tolerance tests such as:

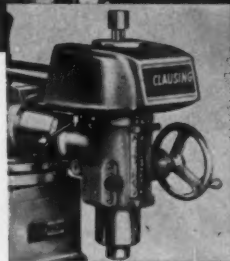
1. Top of table perpendicular to column ways within .0005" in 6" travel.
2. T-slots square with cross slide dovetails within .0005".
3. Table, parallel to turret within .001".
4. Spindle square with table, front to rear, within .001" T.I.R. in 5" circle.
5. Spindle taper (internal) runout within .0002" at spindle nose.
6. Table T-slots parallel to table dovetail ways within .0005" in 8" longitudinal travel.

THE CLAUSING VERTICAL MILLER is a precision machine tool designed for general production milling . . . pattern, experimental and tool room use.

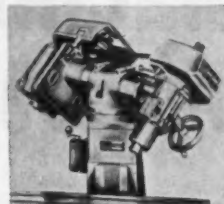
It has sensitivity you don't get in larger machines. That really pays off in accuracy and efficiency on *every* job using small cutters.

And, the Clausing is an outstanding producer — "most versatile, easiest to set up, get around and operate of any miller at or near its low price". Only \$875 f.o.b. factory. See it before you buy *any* mill.

Write for Free Literature



The high precision spindle and drive have 7 ball bearings . . . hardened spindle. Ground and hard chrome plated quill has full length bearing in head.



The spindle head can be swiveled in a vertical plane and set at any angle, and turret rotated in a horizontal plane making it possible to machine at all angles with one set-up.

CLAUSING

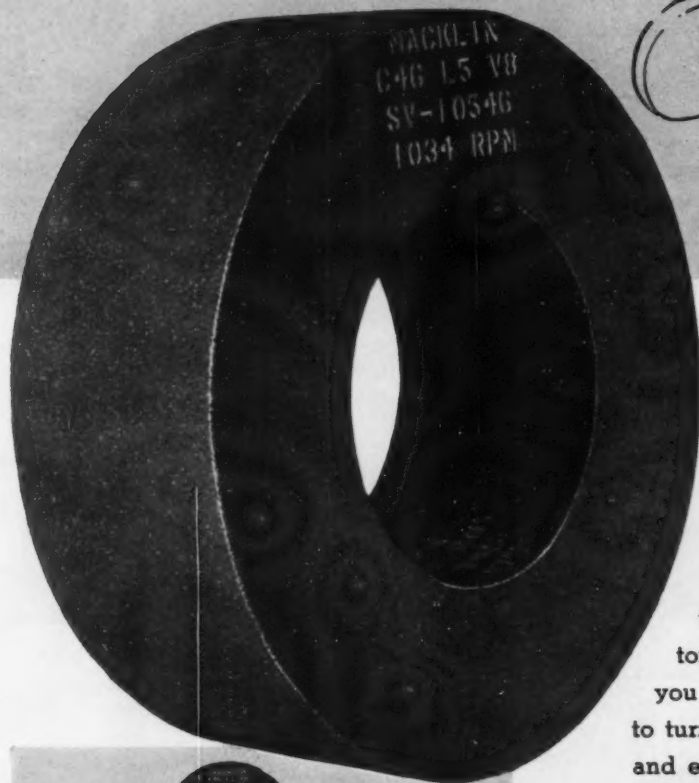
CLAUSING DIVISION

ATLAS PRESS COMPANY

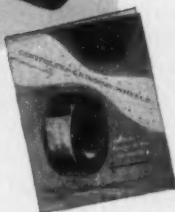
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CENTERLESS

"Wheels of Profit"
by MACKLIN



MACKLIN Centerless Wheels are available in a complete range of sizes and gradings. Standard and special regulating wheels are also available.



for uniform, **HIGH SPEED PRODUCTION**

Whether you finish bolts, bars, rods or tubes... bearings, tappets, pistons or piston rings... twist drills or plastic parts... you can depend on Macklin centerless wheels to turn out *identically* ground pieces quickly and economically.

They cut cool and sharp. They have good balance. Uniform dispersion of abrasive grain through the wheel enables you to hold part size uniformly and to obtain good finish.

HERE'S PROOF

ROUGH GRIND PINION SHAFT "Good stock removal. Finish excellent. Have standardized on this wheel."
20x6x12 C60 L5 V8

FINISH HIGH SPEED CARBON DRILLS "Wheel very satisfactory. Production increased materially."
20x8x12 18A 100 N5 V6

It Will Pay You TO CONSULT WITH YOUR MACKLIN DISTRIBUTOR.
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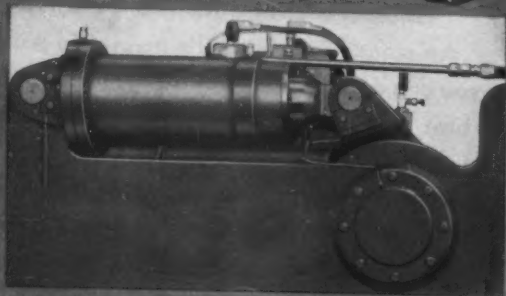
GRINDING
WHEELS

MACKLIN company

Dept. 14, Jackson, Michigan

Introducing a new line of

STEELWELD Pivoted-Blade



RUGGED—SIMPLIFIED HYDRAULIC DRIVE

The drive is simplified and efficient. Only one hydraulic cylinder is used, as compared to two on other machines. Hydraulic components, therefore, are reduced by one-half. No special circuit is required to keep the blade level. This is taken care of by the mechanical linkage.

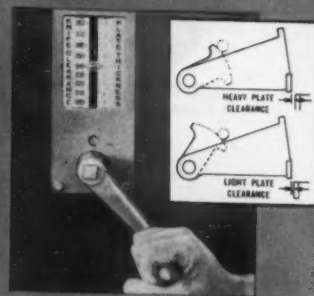
2nd SPEED FOR LIGHT CUTTING—100% FASTER

The single cylinder design provides an important bonus advantage: A second, higher speed for lighter thicknesses. Material up to and including 65% of the rated thickness is cut at double the downstroke full-load speed. The hydraulic circuit automatically changes to a slow speed full-load capacity when required.



CUTTING STROKE QUICKLY ADJUSTED

Both the upper and lower limits of blade travel can be adjusted to suit the work. With the same adjustment, the shear can be changed easily from squaring to slitting operation, or to intermediate position for notching.



FAST KNIFE CLEARANCE ADJUSTMENT ASSURES BEST CUTS

Knife clearance can be adjusted to suit different plate thicknesses. This is quickly done by turning a hand crank at front of the machine. This causes the upper knife to move toward or away from the stationary knife, as indicated in sketches. The scale shows plate thickness that may be cut for any knife setting.

STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. •

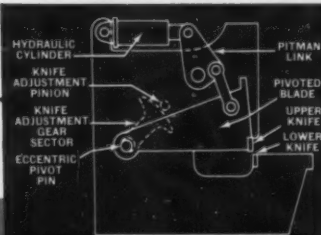
2540 East 283rd Street, Wickliffe, Ohio

HYDRAULIC SHEARS

**Offer a combination
of features found
in no other shear!**

COMPLETE RANGE OF SIZES
FOR CUTTING PLATE WIDTHS
TO 30 FEET

... AND THICKNESSES
TO 2 INCHES



PIVOTED-BLADE DESIGN

A pivoted-blade cutting principle is used. It overcomes certain handicaps of guillotine type shears. There are no slides and guides to wear out of true and cause inaccuracies. The upper blade operates on two heavy pins secured to the end housings and travels in a circular path.

The Steelweld line of Hydraulic Shears is the newest in the Steelweld Machinery Division's fast growing family of metal forming and cutting machinery.

Entirely different from all other shears now on the market, the new machines have a machinery design that is unique and outstanding. They are replete with features that make metal cutting faster, easier and extremely accurate. Construction is heavy and of highest quality to provide long trouble-free service with minimum maintenance.

The hydraulic machines supplement the fine line of Steelweld mechanical shears, thereby making it possible to offer without partiality the most suitable machine for the work contemplated.

Write for free copy of catalog No. 2030

STEELWELD
Mechanical and Hydraulic
SHEARS

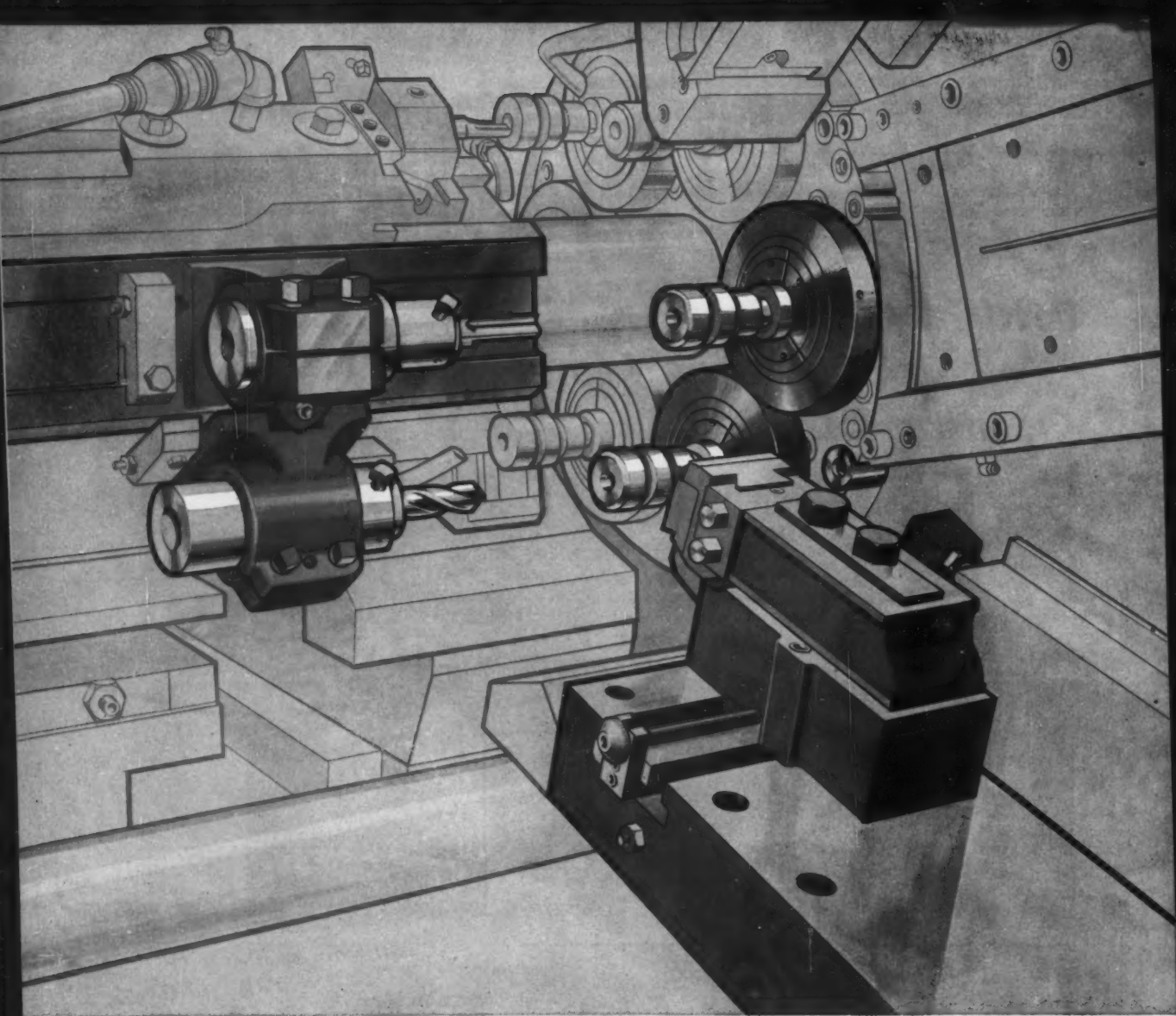


Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.



and many more IMPORTANT ADVANTAGES

NO OVERLOAD DAMAGE—Steelweld Hydraulic Shears have uniform overload protection through the entire working stroke.
LOW FIXED RAKE ANGLE—Minimizes twist, camber and bow in cut pieces. Extra heavy power drive eliminates need of adjustable rake angle.
VARIOUS CONTROL CYCLES—Inching control, safety stroke, single stroke repeat, and single stroke non-repeat are provided on all standard machines.
SAFETY-TYPE FOOT SWITCH—Reduces fatigue and speeds operation. Can be moved around to most convenient location.
QUIET HYDRAULIC HOLD-DOWNS—Positive in operation with adjustable pressure to suit work. Heavily protected from damage.
EXTRA DEEP THROAT—24 inches standard. 36 inch throat depth available as extra for some sizes.
SMOOTH WORKING BACK GAUGE—Sturdily built for long accurate, trouble-free service. Ball bearings throughout. Easily operated with hand crank. Motor drive available.
KNIVES EASILY REPLACED AND SET—One man can turn or completely replace knives and make all adjustments quickly from front of machine.
CONVENIENT POWER PACKAGE—Motor, pump, oil cooler, valves, etc., mounted on oil tank and readily accessible for maintenance. May be removed as a unit from machine.
HYDRAULIC VALVES ON COMMON SUBPLATE—Eliminates considerable piping, fittings and bends. Provides an efficient, disturbing piping. Valves easily removed without

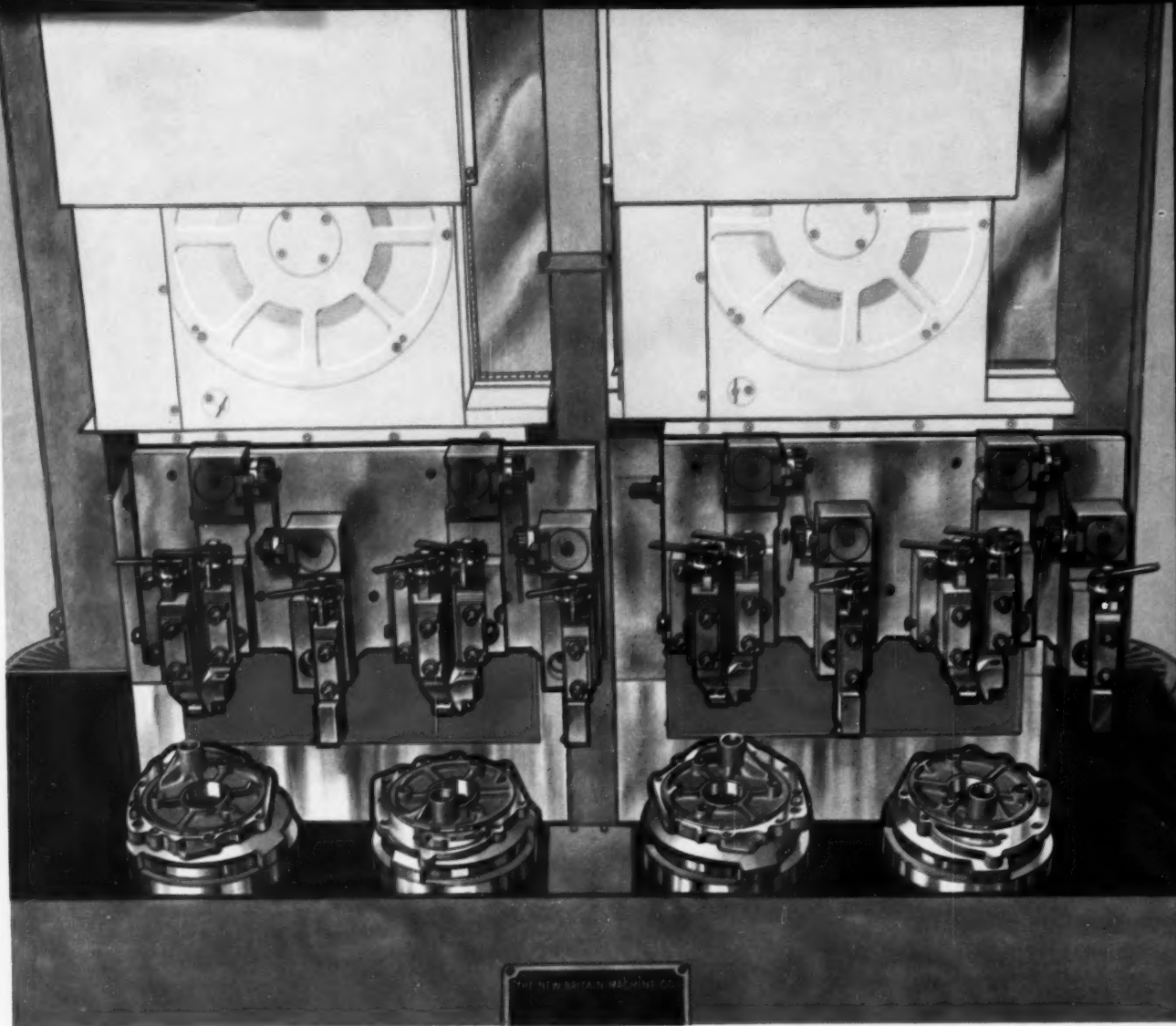


New Britain's answer to a serious threat

Overseas production of just about anything you care to name is making serious inroads on American domestic and foreign markets. It's no secret that European and Asian industry is catching up fast technologically—and they have a real competitive advantage in plenty of low cost skilled labor. While many foreign products are still inferior to those of domestic manufacture, this is far from true in all cases. The answer is, of course, increased productivity at lower cost.

In its all-new line of bar machines, New Britain has developed the most modern bar-turning units available. Five models in two different series are offered with capacities from 1½" to 5½". These machines are designed for really fast, trouble-free, high-precision production. More operations per machine are possible than ever before. Wide open tool areas allow unlimited combinations of end working and forming tools. New Britains will stay new longer. The exclusive wear-preventing features so

familiar to New Britain users have been retained and improved. Catalogs on both the small and large series machines are yours for the asking. After looking this literature over if you think one or more New Britains may help improve your competitive situation, we will be happy to review your prints and arrange a demonstration. No obligation, of course. Call us or call your local representative. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



precision boring—*New Britain's new approach*

New Britain Cam Actuated Vertical Precision Boring Machines offer an entirely new principle for more accurate boring and turning, plus compact exterior design and fast tooling. Rough cuts and finish cuts within close tolerances on the same set-up are characteristic. Standard models are available with maximum swing from 12" to 17½" in 10 or 15 horsepower.

Here are a few of the major new developments incorporated in these unusual machines.

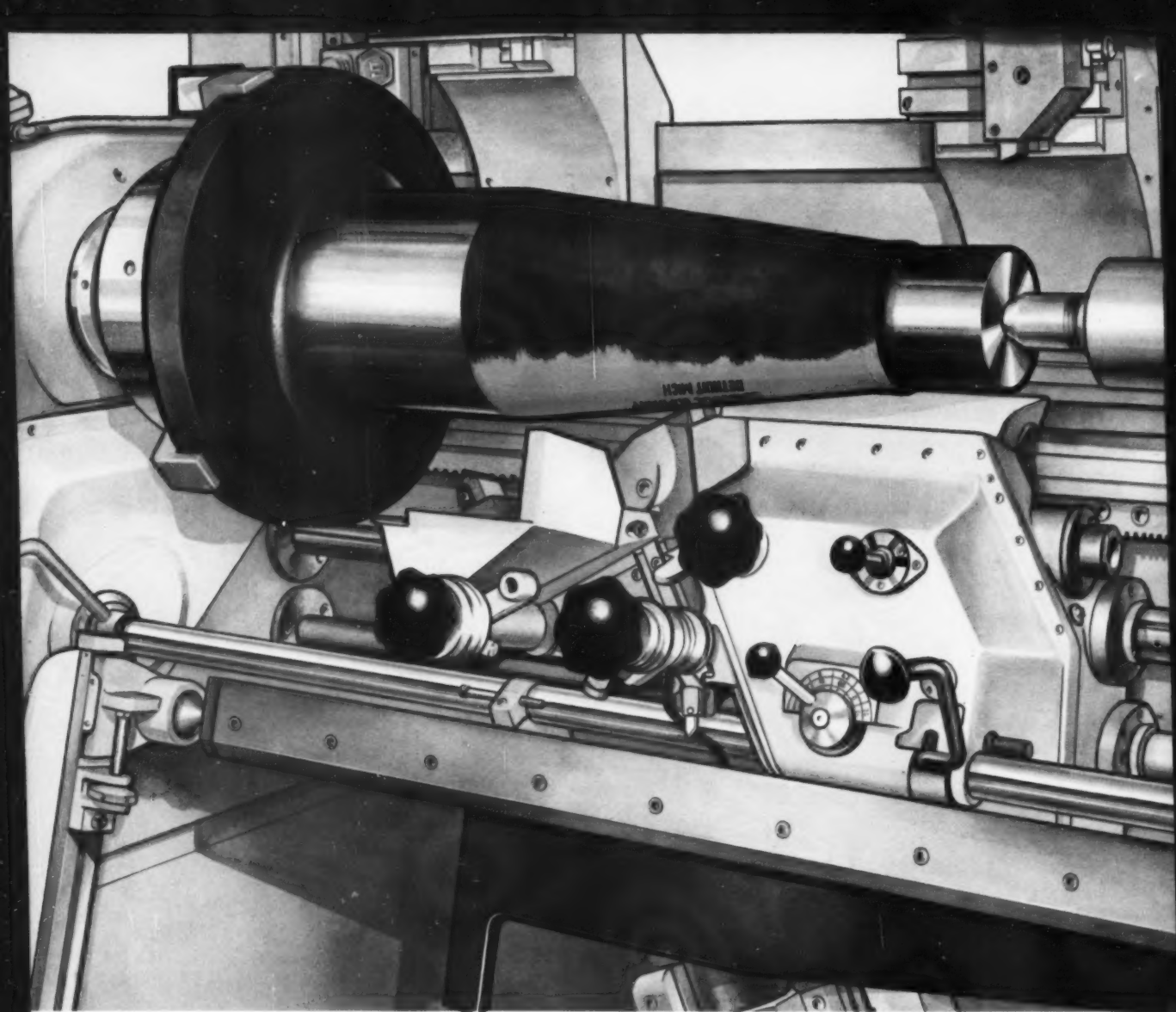
Greater accuracy. Both the vertical and cross slide cams are mounted on a common shaft which is contained inside the vertical slide. The linkages found in conventional cam-operated contouring machines are eliminated. Both the vertical and cross slides ride on preloaded roller bearings and are deflection-free.

Clean-sided design. Any number of these self-contained machines, each with one or more spindles, can be arranged side by side. Depending on how they are tooled, they operate either as a

single unit or as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine, finishing both sides, completing *all* operations in one integrated, high-volume operation.

Fast tooling. Unrestricted accessibility allows rapid tool and cam changes.

Complete catalog material is available. For your copy, write New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



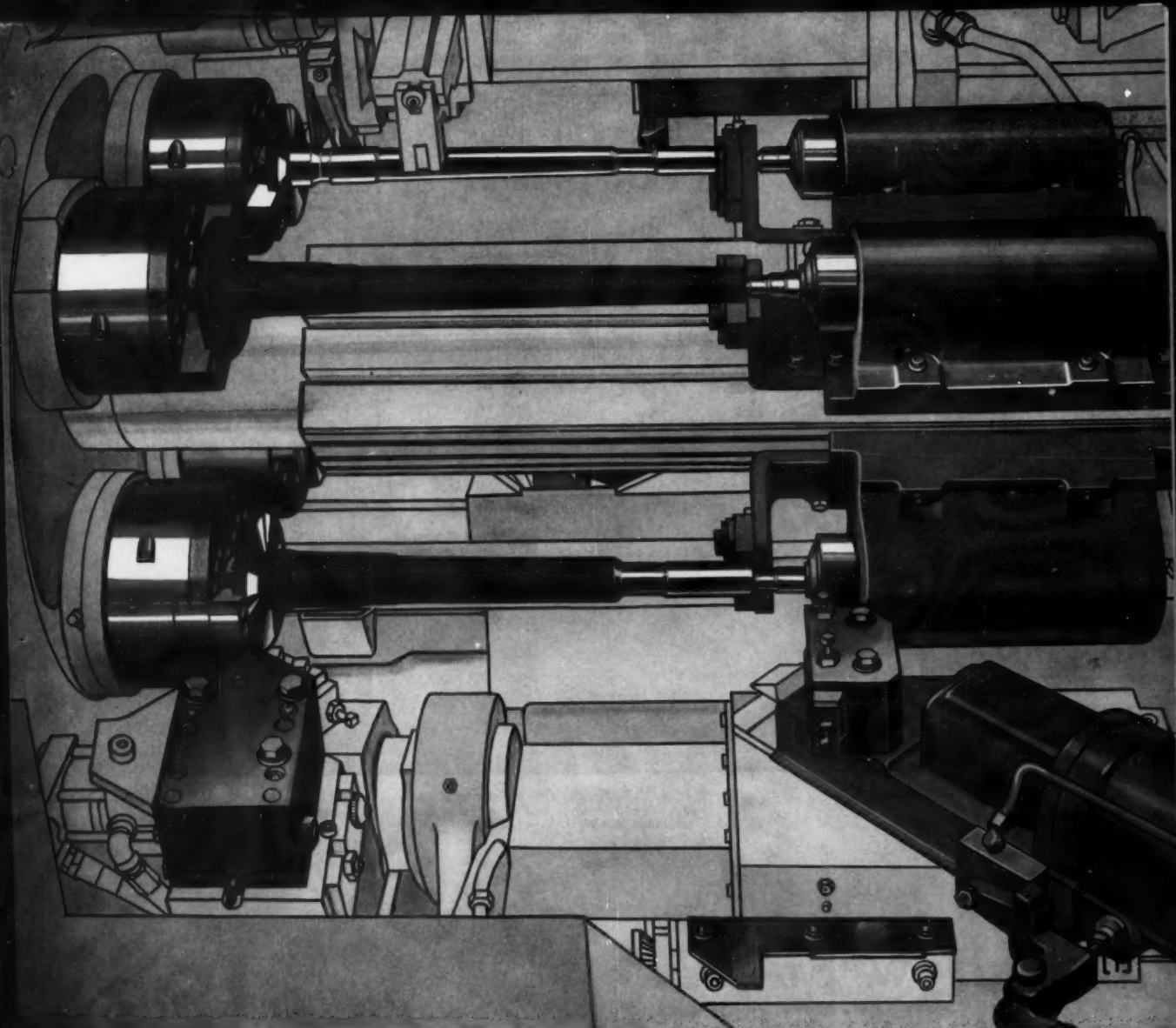
why a copying lathe—why New Britain +GF+

Beyond a certain point sustained production of the same piece on an engine lathe becomes uneconomical. Sometimes, however, the feeling exists that a copying lathe lacks flexibility, power and ruggedness or that it is just too "special." A New Britain +GF+ has power—25 to 40 h.p. The +GF+ has rugged design to handle big work and it's really flexible—a prototype or flat template will reproduce one or more pieces with fast, single point tooling. Whether it's shaft

work or chucking work you have to do, ease of set-up is the same. The template or prototype can be changed in minutes. No special tooling set-ups are required, either. You can quickly switch from intricate cuts on slender shafts to heavy cuts on big castings or forgings (like the one shown). Complex profiling presents no problems even on jobs requiring really heavy metal removal.

Fast set-up and changeover from one

type of work to another is only part of the story. There's much more that you'll want to know about the New Britain +GF+. Watching one of these machines in action is the best way to get the whole story and we'd like to arrange a demonstration for you. If you'd like to look over catalog material, we have that too, of course. Write New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.



idea for volume producers of shafts

Economists are making startling predictions on this year's increase in productivity. They say it will be twice that of recent years — up as high as 10% in some manufacturing industries.

Whether or not these predictions come to pass, it's certain that it won't happen in plants using outdated equipment.

Shaft work is a problem to many firms. New Britain pioneered template-controlled contour turning and boring, solving the problem for many progressive companies. Now for the manufacturer with really high volume require-

ments we present Model 412/25—a four-spindle, template-controlled machine capable of producing a four-fold increase in productivity per man hour.

The basic principle pretty much speaks for itself. As in the case of the single-spindle contour lathe, inexpensive metal templates control the full cycle and re-cycle if required. Simple, single-point tools replace complex gang tooling. Set-up is simple and fast. When tools wear, merely replace them. Since all relationships are maintained by the template, tool replacement involves no problem.

When the volume of contour turning warrants it, this machine can be the best money maker on the production floor. Your New Britain representative can quickly tell you after looking at your prints and learning of your production requirements. Meanwhile, we would be glad to mail you descriptive literature containing the basic facts and specifications. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

PERFORMANCE REPORT



R. J. Huff, Granite City maintenance superintendent, points out Morgoil bearings to J. H. Koester, Granite City lubrication engineer, and W. P. "Sandy" Wehking of Standard Oil.

**How STANOIL
Industrial Oil has been
delivering on 22-year
assignment at
Granite City Steel**

Bearing assembly viewed from inside by J. H. Koester and Sandy Wehking. Sandy Wehking knows industrial lubrication. For 17 years he's been providing lubrication technical service to industrial customers. He studied chemistry at Blackburn College and has completed the Standard Oil Sales Engineering School.



Situation: In 1937, Granite City Steel installed STANOIL Industrial Oil in the Morgoil Back-up Roll Bearings in the five-stand finishing train of their hot strip mill. Each bearing has a load-carrying capacity of more than three million pounds. The oil on which these bearings ride must be of high quality to meet the requirements of this severe service. A narrow viscosity range is required to assure proper operation of the mill throughout the speed range. More than 10,000 gallons of water per minute are used to cool the work rolls. The oil thus must have superior demulsibility to prevent water contamination.

What has happened: Today approximately 1,800 tons rolled is the average shift production. A record of over 2,700 tons rolled has been racked up by one

shift in this mill. STANOIL Industrial Oil has continued to deliver top operating performance under these increasingly demanding conditions. Samples of the oil are taken regularly by the Standard Oil lubrication specialist for laboratory analysis to make sure the oil is maintaining specifications. Stocks of STANOIL Industrial Oil are warehoused by Standard at East St. Louis, only twelve miles away, so that the mill has a ready source for the product whenever needed.

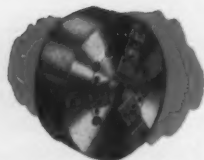
What you can do: Get all the facts about STANOIL Industrial Oil from the Standard Oil lubrication specialist near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana)**, 910 South Michigan Avenue, Chicago 80, Illinois.



*You expect more from Standard
and you get it!*

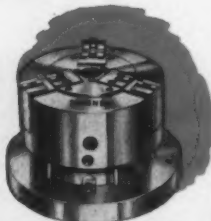
You'll get the job done faster at less cost with Skinner metalworking products

A complete line of hand chucks, power chucks, cylinders, vises



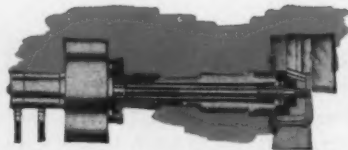
POWER CHUCKS

Provide positive gripping power. Assure accuracy within .001" on diameter on repetitive work. Available in self-centering, combination, serrated jaw, compensating, lightweight self-centering types and in sizes from 6" to 24" diameter. Mount directly on American Standard Type A-1, A-2, B-1 and B-2 flanged spindle noses.



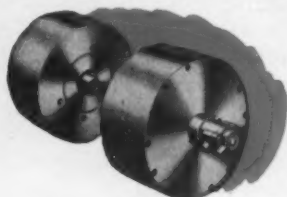
POWER CHUCK FIXTURES

Non-rotating. Hold work for drilling, milling, assembly operations. Air-operated for fast, effortless loading and unloading. In sizes from 5" to 24" with either two or three adjustable or non-adjustable jaws.



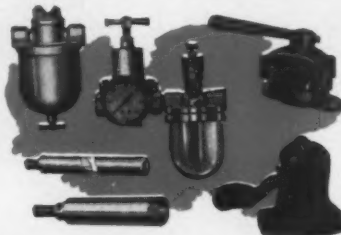
JUNIOR POWER CHUCKING UNIT

Designed to convert small lathes to high production power units. Case histories show users make worthwhile savings. Complete unit includes double-acting air cylinder, adapters, regulator, valve and self-centering chuck with 1/4" to 6" capacity. Components may be purchased separately.



AIR CYLINDERS

Double-acting, rotating operation. Speed production by opening or closing power chuck jaws almost instantly. Large ports assure fast action with minimum air expenditure. Standard sizes range from 4-1/2" to 20". Speeds up to 3500 RPM.



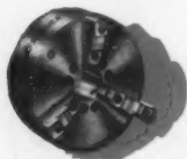
POWER CHUCKING ACCESSORIES

A complete line of power chucking accessories is available: Hand and foot operated valves, draw bars and tubes, air filters, complete air units.



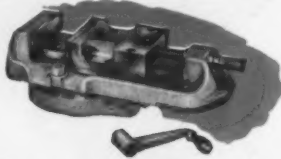
+6F+ WORK DRIVERS

Fastest, surest way to drive 1/4" to 8-1/16" rough or smooth blanks between centers. Used instead of driving dogs. Mount on spindle of any lathe by means of adaptor plate. Engage and disengage workpieces quickly. Positively will not loosen. Have no protruding parts. Hood completely covers jaws. Drivers will work in either direction.



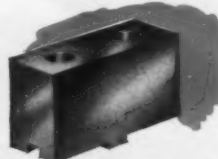
HAND-OPERATED CHUCKS

A large selection of Independent, Self-Centering and Combination chucks. Sizes suited to machines ranging from bench lathes to engine and turret lathes in sizes up to 36". Both direct mounting types and types for use with intermediate adaptor plates.



FULL CAPACITY TROUGH VISES SERIES F AND FS

A complete line of big capacity vises from 4" to 8". Available with or without swivel base. Opening capacity is equal to full width of jaws. Tremendous holding power for rough or finished work. Built-in trough returns coolant to machine table.



SOFT BLANK TOP JAWS

A complete line of medium and heavy duty blank jaws accurately machined to American Standard jaw dimensions. Jaws are low carbon alloy steel which can be carburized and heat-treated to the required hardness—available tongue and groove and serrated jaw types.

Skinner Products are sold through leading Industrial Distributors and Machine Tool Builders and Dealers.



THE CREST OF QUALITY

SKINNERCHUCKS

ESTABLISHED 1887, NEW BRITAIN, CONNECTICUT

- Inflation—Front and Center
- Steel and Machinery Pricing Accused
- Citizens, NAM, Chamber Act
- Washington Briefs



Keeping up with Washington

Loring F. Overman

INFLATION, the villain of a successful economy, strode boldly onto the Washington stage as the year's end neared. Throughout 1959, the political tug of war wavered between the extremes of possible recession and probable inflation. By mid-November, the spreading effects of the long steel strike were seriously curtailing business expansion, but both government and business economists were classifying inflation as the Number One danger confronting the nation in 1960.

Steel and Machinery Pricing Accused

Both steel and machinery pricing were cited as major causes of post-war inflation, in a report made by a study group of the Congressional Joint Economic Committee. Concerning steel, it was observed: "The impact of the increase of steel prices on other industrial prices is large. If steel prices had behaved like other industrial prices, the total wholesale price index would have risen 40 per cent less over the last ten years, and 52 per cent less since 1953. Finished-goods prices would have risen 23 and 38 per cent less in the same two periods. The increase in steel prices is due to the extraordinary rise in wages, combined with only an average increase in productivity; and to the increase in profits, taxes, and depreciation charges, as well. . . ."

The study group had this to say about machinery pricing: "Rising wages and material costs, particularly steel, together with the effects of higher equipment and other capital costs for the machinery-building sector itself, probably account for a failure of machinery prices to fall during recessions, and set the stage for a run-up of prices when demand expands. . . . The impact of inflated capital costs throughout the economy is probably important, but no direct estimate of the effect has been made. A review of the behavior of capital consumption expenditures during the 1955-57 period, however, suggests that the inflation of capital costs was of some significance. The erosion of the purchasing power of personal savings and the lessening of competition resulting from a capital-goods inflation may have inhibiting effects upon the growth potential of the economy.

"Policy implications: Since the major cause of inflation in machinery pricing is a demand pressure in boom periods coupled with a downward rigidity during contractions, any policy that aims at tempering the inflation must grapple with one or both of these facts. Policies which succeed in stabilizing the cyclical behavior of investment demand will probably tend to reduce the inflation of machinery prices, by (1) reducing the demand pressure during expansions; and (2) lessening the risks incurred in the industry, thereby lowering entry barriers and reducing downward price rigidity. Any anti-inflationary policy designed to control demand, whether monetary or

fiscal, will be effective against a capital-goods inflation only to the extent that it reduces the demand for capital goods by other industries."

Citizens, NAM, Chamber Act

Among other approaches to the problem of inflation were these: A citizens' campaign seeking fifteen million individual anti-inflation pledges was launched during November. Addresses by President Eisenhower, Vice-President Nixon, and Senator Robertson (D-Va.) urged pledges to oppose inflationary programs by local, state, and national governments; to buy wisely; and to increase personal productivity.

The National Association of Manufacturers cited three problems and four goals in its recommendation to the Congressional Joint Economic Committee. The problems: rising labor costs, shortage of venture capital, and rapidly increasing competition from other countries for both foreign and domestic markets. The goals: adequate rate of growth in our productive potential; substantially full and continuous use of the potential, including the labor force; reasonable stability of prices; and a determined vow by the American people to resist inflation.

The United States Chamber of Commerce recommended a three-way program of high employment, price stability, and economic growth. Included in the presentation was evidence that the three are not incompatible if carried out with restraint. It was conceded, however, that achieving economic growth by introducing technological changes can result in temporary unemployment by making certain jobs unnecessary. The Chamber contends that such changes spawn other and better jobs.

Washington Briefs

Machinery people having defense contracts will be affected by a new Section XV of the Armed Services procurement regulation. The rulings, which will become mandatory on July 1, 1960, make important changes in allowable-cost items.

Machinery, electrical equipment, and motor vehicles are among many types of products released from quota controls by Great Britain. British import controls on hundreds of items were placed in effect in 1939. Today, only twenty-five are still subject to control; only ten involve "dollar" goods.

Discussing tax reform, Chairman Mills (D-Ark.) of the House Ways and Means Committee expressed the hope that taxpayers would gain a clear understanding of the advantages to themselves and to the nation of a broad, uniform tax base with low rates. These changes will not be made, however, he said, "until enough congressmen have been instructed by their constituents to go ahead with the job of constructive tax reform. . . ."



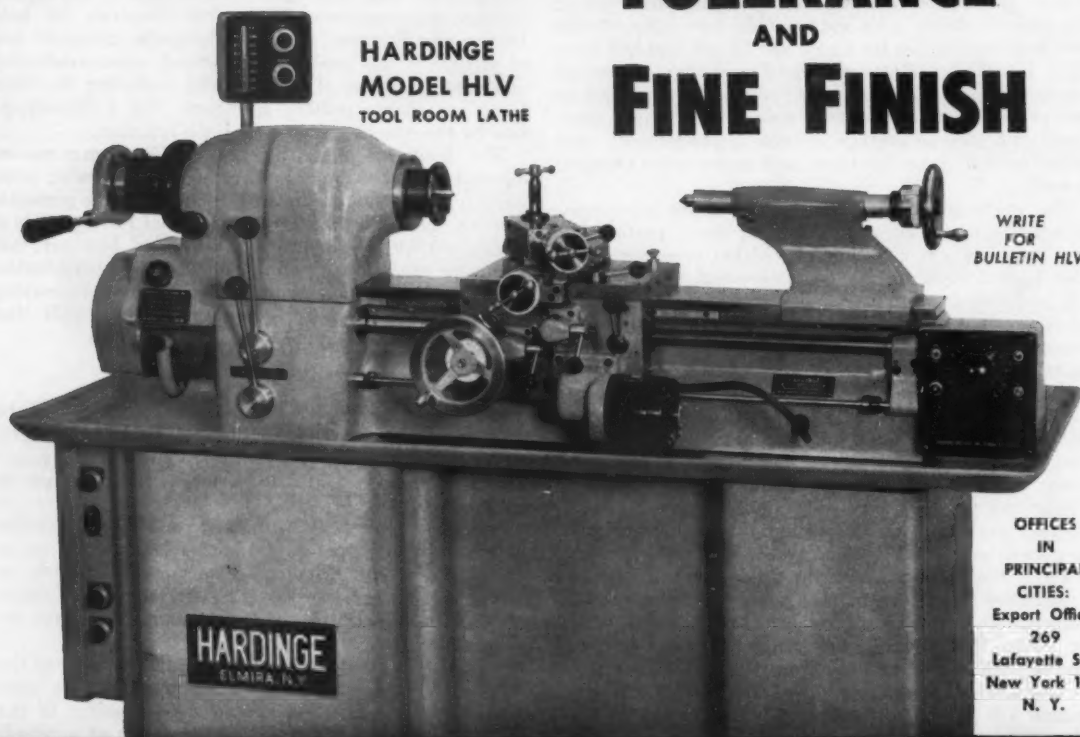
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"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

Accuracy—The Prime Requisite of the Space Age

INFINITE ACCURACY in the construction of vehicles designed for the exploration of outer space is just as important as are the contributions of the scientific brains that conceive the rocket-propelled devices which make newspaper headlines almost daily. To reach approximate positions in space thousands of miles away, components of rockets must be made with a precision heretofore found only in scientific instruments.

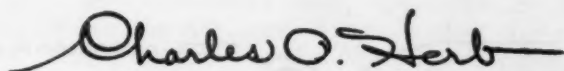
Whereas dimensional limits in the realm of ten-thousandths of an inch have in the recent past been considered almost the ultimate in machining accuracy, today millionths of an inch are specified on drawings of the electronics industry. In days gone by it was a popular custom of shop men and engineers to compare a human hair with the close accuracy required on ground or lapped parts. Such a comparison is wholly inadequate in many shops today, because the average human hair is considered approximately 0.003 inch thick—really a coarse tolerance in shops that turn out nuclear products.

This new conception of accuracy has presented a challenge to the builders of metal-

working machinery and suitable inspection equipment. Special machinery has been mainly used in finishing parts to specifications of "millionths." The day of production machinery for achieving such accuracy on part after part appears to have dawned. This issue of MACHINERY describes a machine designed for turning, boring, and grinding parts on a production basis within 25 millionths of an inch. The operating slides can be moved to 120 *settings* within a space as narrow as the diameter of a human hair!

The manufacturers herald this machine as "the most accurate production machine tool in the world today." All movements are derived from an electronic "brain" instead of human hands. Numerical control is applied to making parts for missiles, aircraft, computers, and other products. It may be said to translate the theories of scientists into the realities of space travel.

This development emphasizes once more the ingenuity of the metalworking industry that enables it to surmount any and all manufacturing problems. A gratifying reflection—because such problems will always be present.



EDITOR

METALOGICS

RYERSON PLUS VALUES

...the Ryerson science of giving optimum value for every purchasing dollar.

...how it works for you

Broadens Scope of Selection

Know a single source where you can get aircraft-quality alloys such as 9310, Nitralloy, and 4340 to A.R.T.C.-14 ... as well as all standard commercial alloys and free-machining types? This is typical of the size and diversity of Ryerson stocks. Here, right at the tip of your dialing finger, are thousands of tons of steel and aluminum—in virtually every standard type, size and shape. Also, hard-to-get intermediate sizes and special analyses are readily available. This is true of Ryerson stocks, year in and year out—in all but periods of extended production shutdowns.

Brings Newest Developments

Remember when lead was first added to carbon steels for faster machining...when, a little later, leaded alloys came along? Ryerson stocked them for you first. And remember just recently when the world's fastest machining steel tubing and bars (Ledloy® 170 tubing and Ledloy 375 bars) were introduced? Again, Ryerson brought them to you first.

Gives New Measure of Quality

Quality—now there's a word that's worn thinner than an office-seeker's shoe sole. But Ryerson Metalogics has given it new meaning, with a brand-new set of rigid quality-control standards that are completely detailed and published for your scrutiny. They govern every aspect of specifications, verification, packaging, cutting and certification of all Ryerson products. If you want a tangible example of the scope of this new quality program, take a good look at Ryerson cutting tolerances. Then see if you can find any that are held more closely.

Provides Best Technical Help

"Expert" is another worn-out word we hesitate to use. But we do put at your disposal the industry's most experienced men. They're ready to give you the benefit of their nationwide, daily experience with all kinds of problems—material selection, fabrication and the ever-present specter "cost of possession." And remember, nowhere else will you find as wide a range of published technical information to help you in your metalworking operations. It's yours for the asking.

Builds Solid Business Relationship

Here's a company you should get to know better for our primary business is that of satisfying customers. And we've kept a lot of people satisfied over the last 100 years. We'd like to satisfy you, too.

Meets Your Most Exacting Schedules

What do you need right now... tomorrow... or in the future? Whatever you need, Ryerson is there—"the fastest with the mostest"—exactly when you need it—as you need it.

Why not discuss the exciting story of Metalogics with your Ryerson representative soon. You'll find he can help you in more ways than you might think—to meet all your requirements for steel, aluminum, plastics and metalworking machinery.

Be "METALOGICAL"—call Ryerson



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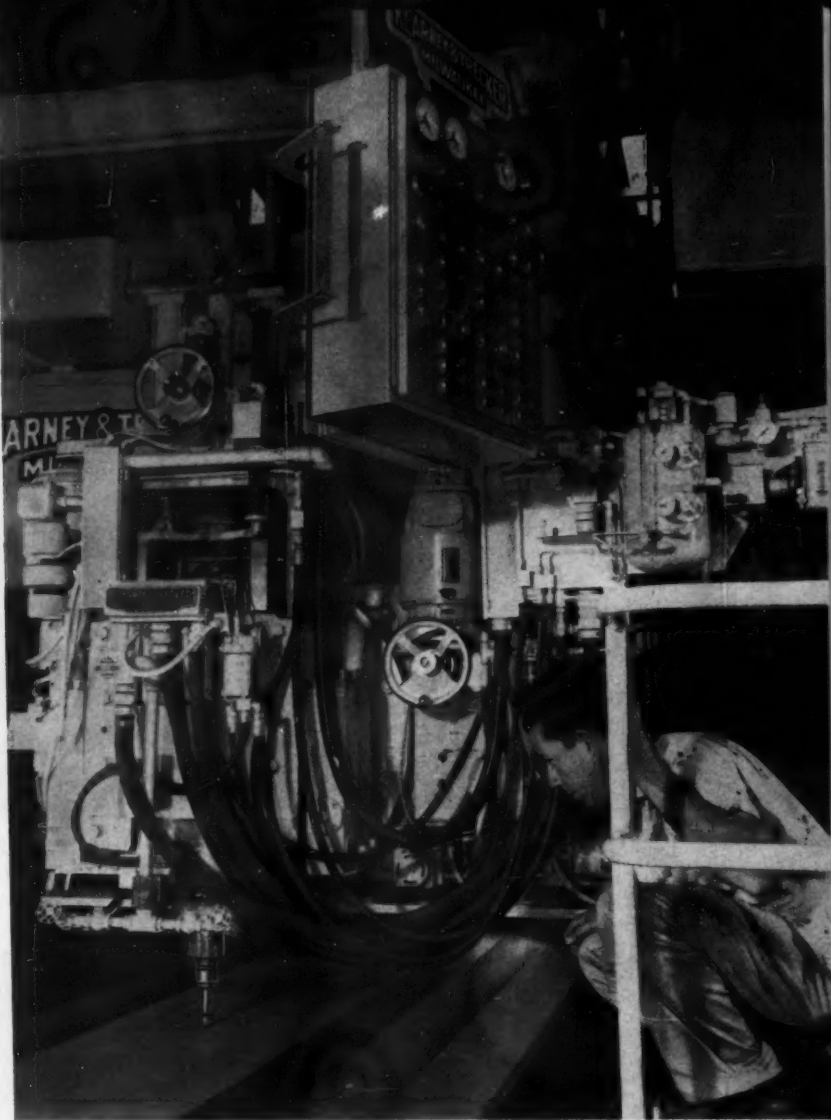
MACHINERY

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Tape-controlled and other modern machine tools have been installed for requirements of present and future manufacturing programs

CHARLES O. HERB, Editor



North American Tooled Up for Fighters and Bombers of the Future

MANUFACTURING OPERATIONS in the aircraft building factories of North American Aviation, Inc., located at International Airport, Los Angeles, Calif., are based on the premise that fighter planes will continue to take a prominent part in any possible war of the foreseeable future. This opinion is, of course, shared by many responsible military leaders. One of the important projects of the concern at the present time is the building of prototypes of the Valkyrie supersonic intercontinental bomber which will be capable of

speeds in excess of 2000 miles per hour at ceilings above 70,000 feet.

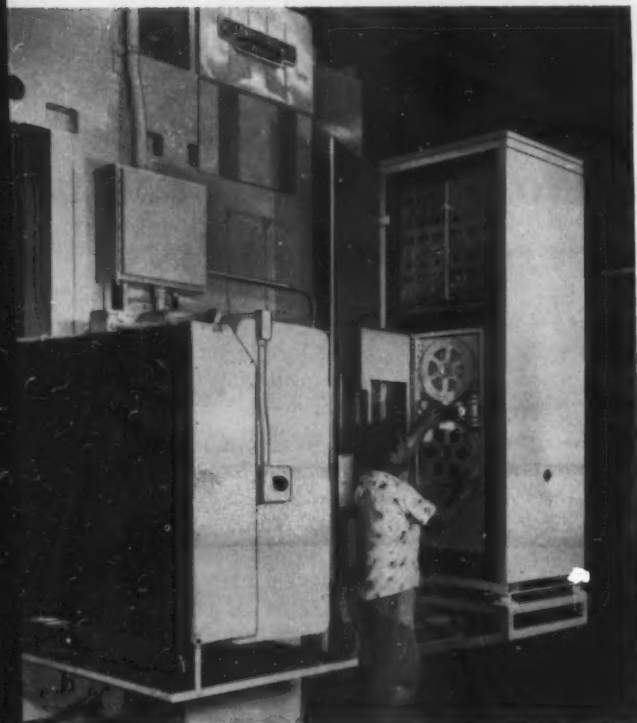
North American is also in production on the T-39 Sabreliner jet utility trainer for the Air Force, the A3J attack weapon system, and the T2J jet trainer for the Navy. Other types of manned aircraft are in regular production.

To insure maximum efficiency in manufacturing operations that are entailed in carrying out programs such as outlined, the firm has installed a number of modern and unique machine tools



Fig. 1. Tape-controlled skin-milling machine which has a table 12 feet wide by 45 feet long. The huge housing runs on ways 24 inches in width.

Fig. 2. All of the tape-control equipment and electronic panels are mounted on the end of the housing itself.



during the last year. Outstanding examples of this new equipment will be herein described.

The Kearney & Trecker skin-milling machine in Fig. 1 will accommodate sheets up to 12 feet wide by 45 feet long. Aluminum-alloy skins in which hundreds of pockets must be milled are conveniently machined to precise specifications under the direction of a tape control system. On some work of appreciable thickness, deep areas are machined away for lightness, thin ribs being left between such areas to provide the required strength. Ribs and wide areas between them can be milled to any desired contours. Sheets and plates can also be finish-milled around their periphery. The work is held firmly on the table by a large vacuum chuck, the table being stationary.

The milling heads are carried on a cross-rail type of housing that moves lengthwise along the bed on this gantry type machine. Cuts can be taken both longitudinally and transversely and in either direction. The housing travels on ways 24 inches in width which are covered to protect them from chips and dirt. Similar protection is also provided for the milling-head feed-screws and for the sliding surfaces of the milling heads. A close-up view of one milling head is shown in the heading illustration.

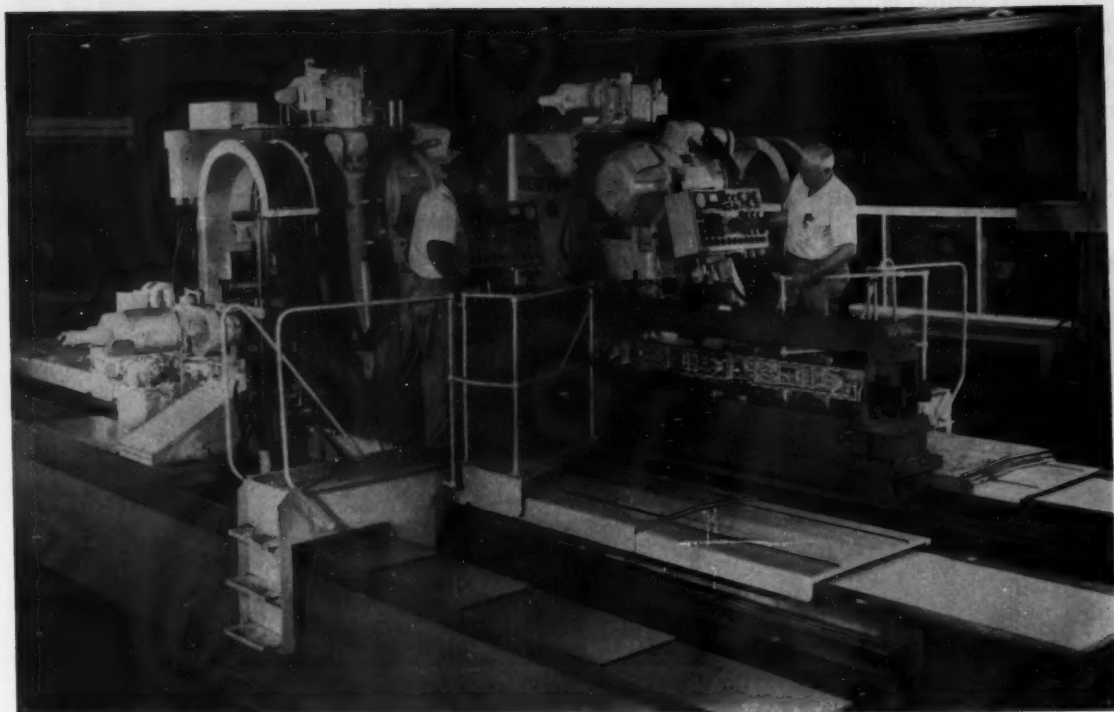


Fig. 3. Double-head milling machine which is also tape-controlled for the simultaneous machining of configurations on both sides of long, complex parts.

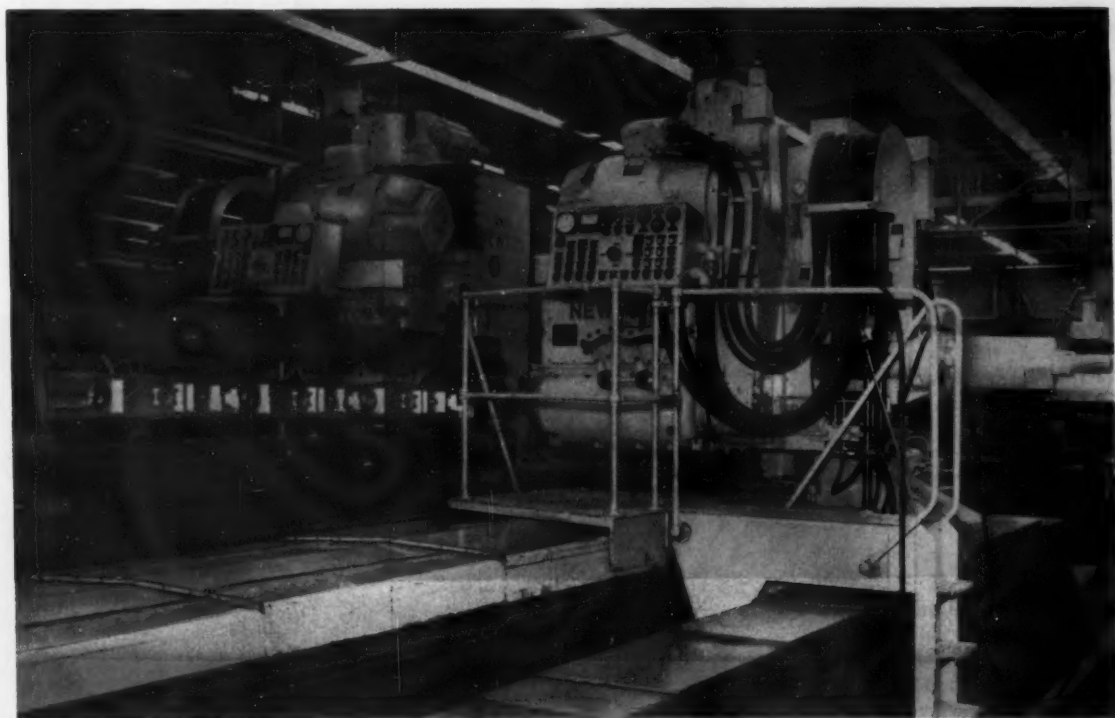


Fig. 4. Another view of the double-headed, tape-controlled milling machine which particularly illustrates the right-hand milling head.

The tape-control equipment and all electronic panels are mounted on the huge housing and ride with it, as will be apparent from Fig. 2. Spindle speeds of 1800 and 3600 rpm are available on this machine. Small-diameter end mills are customarily used for all but facing cuts.

The Newton double-head milling machine seen in Fig. 3 simultaneously takes end- and

face-milling cuts on opposite sides of long flat extrusions. Cavities are gouged out to various configurations. All movements of the cutter-heads along the work, as well as the in-and-out and up-and-down movements of the cutters, are tape-controlled. The tape-control equipment is installed in a cabinet at the right-hand end of the bed and is not visible in the illustration.

The machine is operated manually in setting up and can also be run in this manner in machining parts when only one of a given kind is required. Spindle speeds from 15 to 3600 rpm are available to suit a large variety of jobs. A view of this machine from the right-hand side is shown in Fig. 4.

A magnetic control also governs the operation of the Giddings & Lewis three-dimensional profiling machine illustrated in Fig. 5. This machine is used extensively for scribing and milling master-model templates. Engineering models of planes used in testing the efficiency of aircraft contours in wind tunnels can be handled on a Giddings & Lewis five-axis machine of this type which has most recently been installed in the same department.

Another tape-controlled machine used in profiling operations of small work is shown in Fig. 6. This Morey machine, however, can also be conveniently operated manually. It is used extensively on prototype parts and for producing elements for jigs and fixtures and for scribing and milling engineering templates and master-model templates. The spindle is driven by a 30-hp motor and can be operated through a full three-axis operating range. Cutting speeds up to 100 ipm (inches per minute) are available, the spindle speeds being variable from 20 to 3600 rpm.

Probably the most versatile of the new machines are two Sundstrand Omnimils, of which

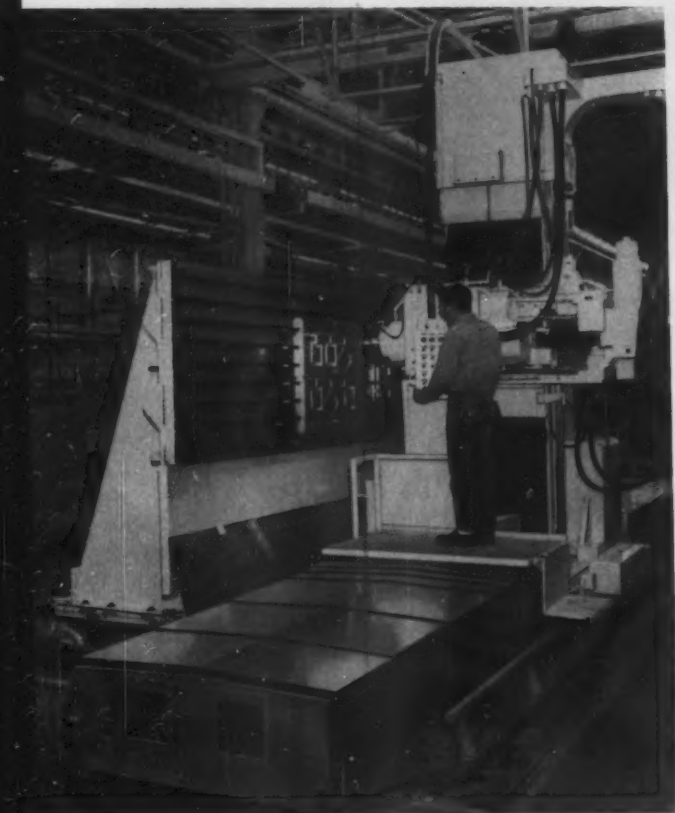
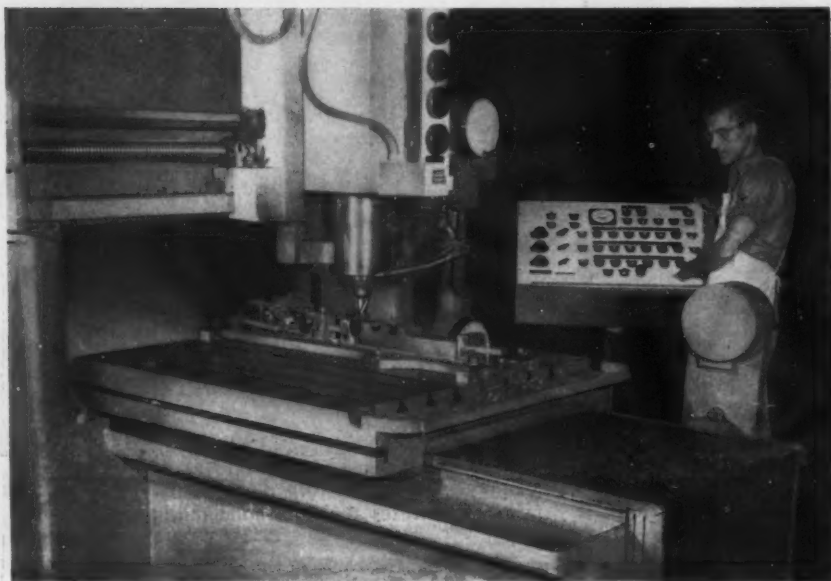


Fig. 5. Remington-Rand punched cards completely control the operation of this three-dimensional profile-milling machine.

Fig. 6. Another profile-milling machine which may be operated under the control of a tape or manually to accommodate a large variety of medium-sized work.



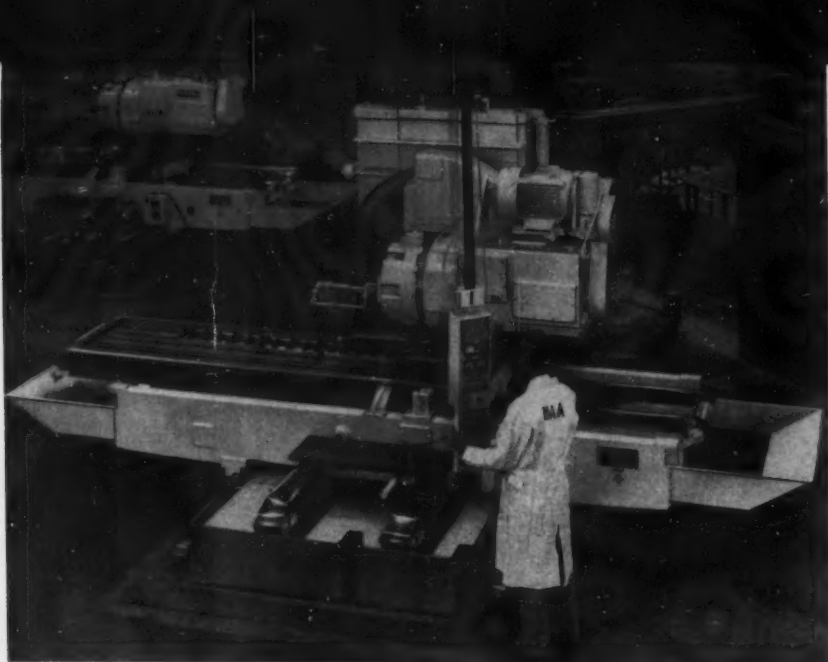


Fig. 7. One of several Omni-mil milling machines which provides maximum versatility through low- and high-speed spindles that can be placed in any angular position.

Fig. 8. Vertical milling machine extensively used for the hot milling of different types of stainless steels at speeds appreciably faster than possible with cold milling.

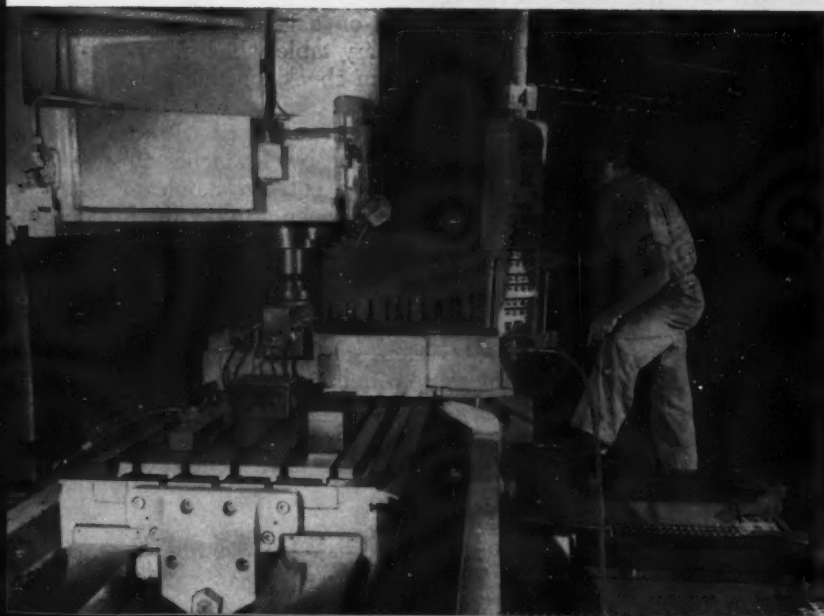
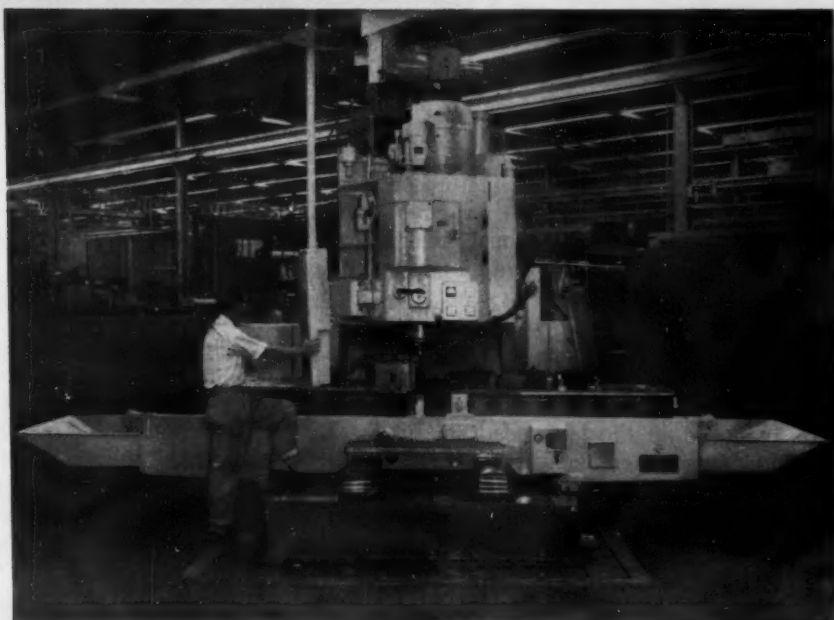


Fig. 9. Close-up view of a hot-milling operation showing the work-piece held in a fixture equipped with Cal-rod heating units.

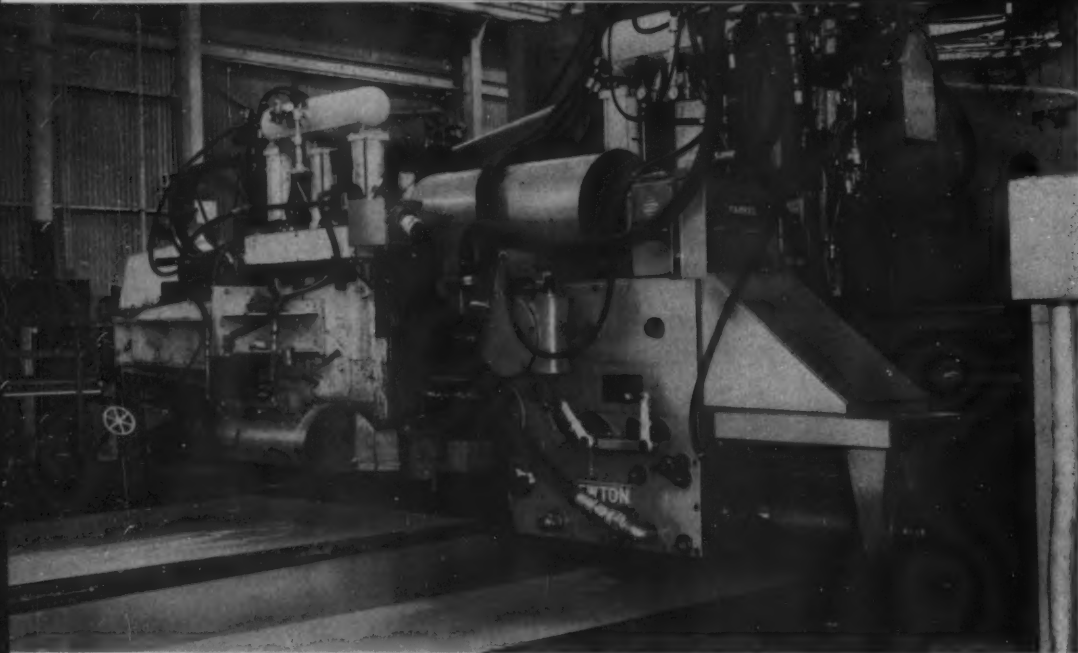


Fig. 10. Huge machine equipped with two spindle heads for horizontal, vertical, and angular milling. The left-hand head will produce all types of configurations on a large part under the control of a cam-bar and roller.

one is shown in Fig. 7. The feature of this machine is a double-spindle head which can be positioned to any angle, thus minimizing the amount of work handling in milling a work-piece that must be machined on several surfaces in a number of planes.

A low-speed spindle nose extends from one end of the milling head and a high-speed nose from the other end. Speeds from 10 to 330 rpm are available on the low-speed spindle for machining ferrous metals and from 47 to 1480 rpm on the high-speed spindle for milling nonferrous materials. Boring can be performed in addition to angular, cross, end, and slab milling. Power feed rates are infinitely variable between 1/2 inch and 200 ipm for longitudinal and transverse movements and from 1/4 inch and 100 ipm for vertical movements.

The center section of the spindle-head unit carries the motor and transmission gearing. This unit has sufficient bulk and rigidity to absorb cutter vibration under the heaviest cuts.

Adjacent to the Omnimil milling machines are two vertical Sundstrand Rigidmils of the type illustrated in Fig. 8. These machines are also applied to a variety of work, including hot machining. In hot machining, the part is placed in a special vise equipped with Cal-rod units for heating to a maximum of 1200 degrees F. Such an operation is seen in Fig. 9. The best tool life is ordinarily obtained with the work-piece heated to 800 degrees F.

In hot machining AM-355 corrosion-resistant steel, Rene-41 alloy, and H-11 alloy, a substantial increase in stock removal has been accom-

plished. Carbide inserted-blade face mills are employed and solid-carbide end mills. In hot-machining operations with a 6-inch-diameter face mill, a spindle speed of 550 rpm is used, together with a depth of cut of 0.150 inch and a table feed of 15 ipm.

These milling machines are equipped with a 50-hp vertical-spindle head. Spindle speeds range from 14 to 1540 rpm. The head has a vertical feed range from 0 inch to 50 ipm, in either direction. The table has a longitudinal travel that can be changed at various rates from 0 inch to 250 ipm, also in either direction.

A huge Betts machine converted with a horizontal milling head on the left-hand end of the cross-rail and a vertical milling head on the right-hand of the cross-rail is shown in Fig. 10. The cross-rail is mounted on a gantry housing that travels over a stationary table which measures 18 by 25 feet. Vacuum chucks on the table hold the work firmly in place.

The right-hand head is seen equipped with a cutter 10 inches in diameter by 12 inches in width for taking slab-milling cuts on stainless-steel sheets. This spindle head can also be fitted with face mills, or narrow milling cutters of the circular type. The left-hand head is provided with a face-milling cutter that operates in a vertical plane, although this head can be used for taking cuts at various angles. This head is also arranged for contour milling under the control of a cam-bar attached to the table. A roller running on the cam-bar causes the cutter to rise and fall as required during its movement back and forth over the work.

Two different pieces of work can be machined simultaneously by the two spindle heads, as will be apparent from the illustration. Spindle speeds from 12 1/2 to 1000 rpm are available for the right-hand head and up to 3600 rpm for the left-hand head. The right-hand head is driven by a 200-hp motor and the left-hand head by a 60-hp motor.

Abrasive-belt grinding of such diverse materials as honeycomb core and sheets of titanium alloy and stainless steel is accomplished by the Farnham machine illustrated in Fig. 11. A vacuum chuck is employed for holding work sheets firmly to the 40-foot long table. In the case of honeycomb sections which are mounted

on "ice chucks," the latter are also held to the table by vacuum.

The abrasive belt on this machine is 88 inches wide. It runs over a long, rubber-faced roller about 14 inches in diameter at the bottom of the cross-rail and over a similar roller at the top of the cross-rail. The belt is 138 inches long. Silicon-carbide belts of 80 grit are used for rough grinding such materials as titanium alloy, while 240-grit belts are used for finish grinding. Aluminum-oxide belts are used on stainless steel, but they tend to produce a smearing effect on titanium alloy.

Metal sheets have been ground with this equipment to as thin as 0.006 inch and produced



Fig. 11. Machine equipped with an abrasive belt 88 inches wide for the grinding of titanium-alloy and stainless-steel sheets and for the grinding of honeycomb core as here illustrated.

Fig. 12. Machine in Fig. 11 being used for the grinding of a titanium sheet.

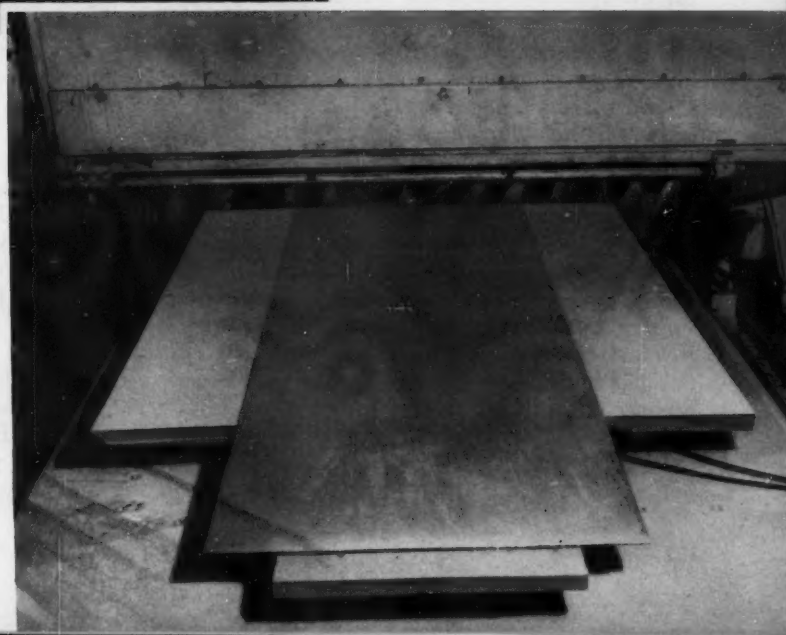


Fig. 13. Modified hydraulic planer being used for flat-grinding operation on a large section of honeycomb core.

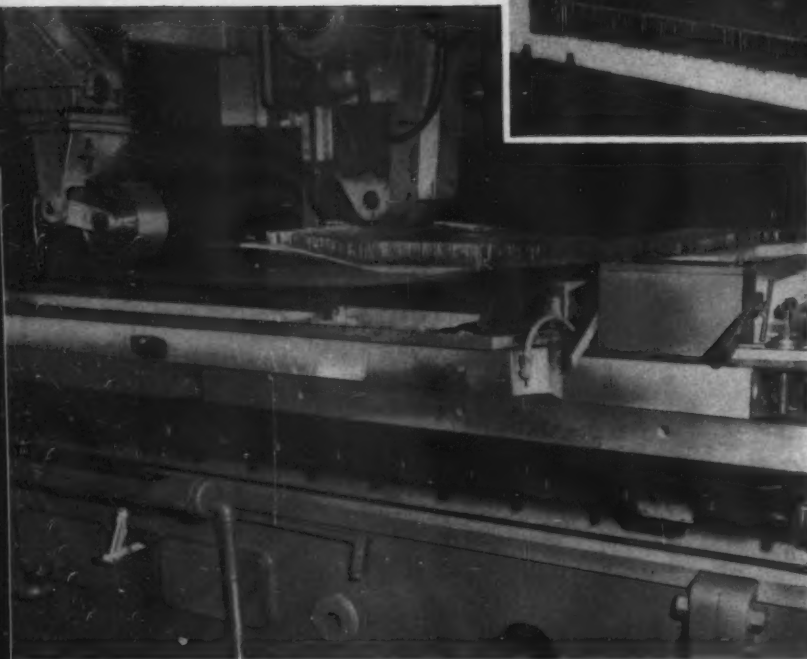
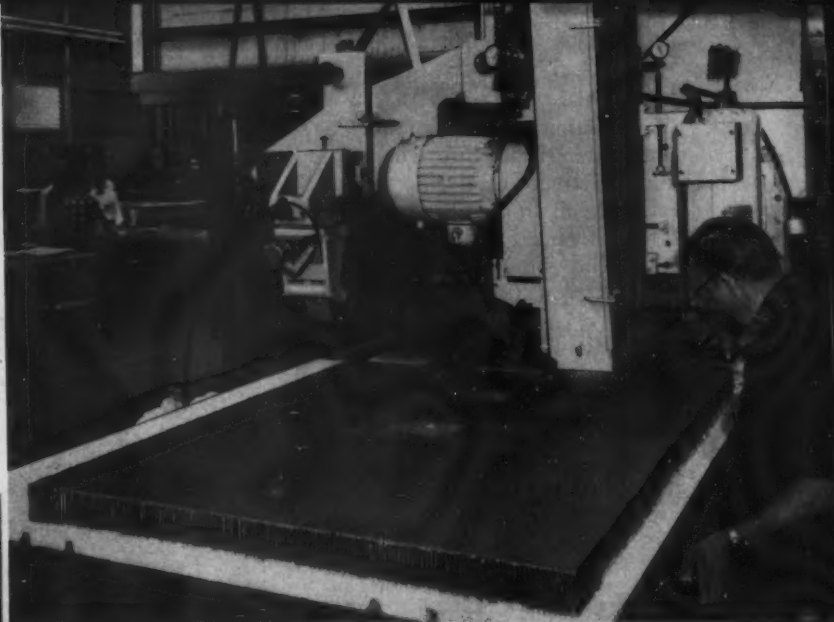


Fig. 14. Machine in Fig. 13 being employed in a contour-grinding operation on a honeycomb core. The rise and fall of the grinding unit are controlled by an epoxy master and roller on the left-hand side of the table.

to the specified thickness within plus or minus 0.001 inch. The finish is generally in the nature of 32 micro-inches. Table feeds up to 120 feet per minute are used.

In Fig. 12 a tapered skin is being ground. Such skins are held on either fixtures having a permanently slanted top surface or an adjustable holding surface. All grit worn off the abrasive belt is carried away by the grinding coolant to a conveyor belt of paper filter and on to a hopper.

Honeycomb core is also ground flat or to required contours on a modified Rockford hydraulic planer, equipped with an abrasive belt. This machine is shown in Fig. 13 being used for a flat-grinding operation on a honeycomb core mounted on an ice chuck. The wheel is held at a constant height above the planer table as the table reciprocates back and forth.

A contour-grinding operation is illustrated in

Fig. 14. In such an operation, the abrasive-belt unit is raised and lowered as a roller at the left of the grinding unit moves up and down on the contours of an epoxy master mounted on the machine table to the left of the work. The abrasive belt is 4 inches wide.

Approximately 0.025 inch of stock is removed from the honeycomb core in rough grinding, and about 0.002 inch in finish grinding. The specified tolerance is generally plus or minus 0.002 inch. Work up to 4 by 8 feet can be accommodated.

Ice, to a thickness of 1/4 inch, is formed at the bottom of a honeycomb core to attach it to a steel plate prior to machining operations. In forming the ice, distilled water is sprayed through the core openings and frozen. This amount of ice is sufficient to hold the core firmly to the steel plate, the latter, of course, being held on the planer table by vacuum.

Programming Technique Assigns Work to Machines

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LINEAR PROGRAMMING, one of the new tools of the operations-research analyst, makes it possible to assign work to machines in an optimum manner. The technique has been so simplified that only elementary arithmetic is needed.

It can be used where a number of jobs are to be processed on a group of machines which perform the same type of operation but have different production rates. An example would be a stamping operation which could be performed by any one of the punch presses in a group containing old and new machines, machines made by different manufacturers, machines with overlapping capacity ranges, foreign-made machines, or machines which for any other reason might have different rates of production.

The following example demonstrates the procedure. A medium-size company finds that after supplying its own needs it has 440 screw-machine hours available per month for outside work. Four machines are involved, as indicated in Table 1. The sales force obtains orders for six different items, to be delivered monthly in the quantities indicated in Table 2. A 5 per cent overrun is acceptable.

The first step in scheduling the six orders to the four machines is to determine how long it takes to make one of each item on each machine. The next step is to find out how many pieces can be made per hour, by dividing the number of seconds it takes to make one piece into 3600 seconds. Eighty per cent of this figure represents the number of pieces which can be made in a standard machine hour (the efficiency). Table 3 lists the hourly production of the six items possible on each of the four machines.

In the third step, the hours required by each machine to completely fill each of the six orders is determined. This is done by dividing the number of pieces which each machine can make per hour into the total number of pieces required. The results appear in Table 4. For ease in assigning work to the machines, Tables 3 and 4 are then consolidated (Table 5).

It is now possible to assign work to the machines by inspection. To record the assignments,

Table 6 is prepared. In linear-programming, this table is called a "solution matrix."

To fill in this matrix, the item which can be produced at the highest rate per hour is first located on Table 5. In this instance, it is Item E, 2205 of which can be produced per hour on Machine 2. Then, a check is made to see if Machine 2 has sufficient hours available to produce the complete order. The machine has 140 hours available and only 80 hours are required to produce the full allotment, so Item E is assigned to Machine 2. This is indicated on the solution matrix by entering 80 in the matrix location corresponding to Item E, Machine 2, and encircling it to show that this order has been completely filled.

Had the hours required to produce Item E been more than 140, the item having the next highest rate coincident with being produced within the machine time available would be

Table 1. Open Time on the Four Machines

Machine	Standard Hours Available*
1	120
2	140
3	100
4	80
	440

* Standard hours equal 80 per cent of rated capacity to allow for setups and miscellaneous down time.

Table 2. Monthly Deliveries Promised on Items

Item	Quantity
A	30,625
B	37,500
C	126,000
D	64,000
E	176,400
F	54,600

located instead. When the hours required to complete an order are greater than the available hours of a particular machine, more than one machine must be assigned to the job. This is not desirable in making initial assignments, since it is preferable to first assign work to machines which can produce an entire order without requiring additional tooling and setups.

Other work is now assigned to Machine 2, since it has 60 hours left (140 minus 80). The next greatest number of pieces per hour which can be produced by Machine 2 is Item A, with 25 hours of the machine's time required to produce the lot. Therefore, Item A is assigned to Machine 2 by entering 25 in the appropriate matrix location and encircling it. This now leaves 35 hours (60 minus 25) available.

Following the previous procedure, it is found

that Item D can be made on Machine 2 in 33 hours. However, this would leave 2 hours of idle time, so the assignment is not made. Instead, the next highest number of items which can be completely produced by a machine within the hours that machine has available is determined. This would be 1250 of Item B on Machine 3, requiring 70 of 100 available hours. There are no other complete lots that can be handled by Machine 3 in the time available.

Continuing, it is found that Item D can be made on Machine 1 in 80 of 120 hours, so this assignment is made. Machine 1 can produce no additional complete orders in the time available.

Machine 4 can produce 780 pieces of Item F in 70 of 80 hours, so this assignment is made. Items A, B, D, E, and F have now all been accounted for, leaving only Item C.

Table 3. Hourly Production at 80 Per Cent Efficiency

Machine	ITEM					
	A	B	C	D	E	F
1	778	705	668	800	684	*
2	2025	1310	1800	1920	2205	994
3	1110	1250	994	960	1152	1028
4	825	847	740	720	765	780

* Cannot be run on this machine.

Table 4. Number of Hours Each Machine Takes to Process Each Order

Machine	ITEM					
	A	B	C	D	E	F
1	63	120	189	80	259	*
2	25	67	70	33	80	55
3	46	70	127	67	154	53
4	61	103	170	89	238	70

* Cannot be run on this machine.

Table 5. Consolidation of Tables 3 and 4

Machine	ITEM					
	A	B	C	D	E	F
1	778	705	668	800	684	0
	63	120	189	80	259	0
2	2025	1310	1800	1920	2205	994
	25	67	70	33	80	55
3	1110	1250	994	960	1152	1028
	46	70	127	67	154	53
4	825	847	740	720	765	780
	61	103	170	89	238	70

Table 6. Solution Matrix

Machine	ITEM						Available Hours
	A	B	C	D	E	F	
1		...	40	80		0	120
2	25		35	...	80	...	140
3	...	70	30	...	...		100
4	...	...	10	...	...	70	80
Total	25	70	115	80	80	70	440

The remaining available hours of each machine will all be used to produce Item C. These allocations are not encircled, indicating that no one allocation completes the entire order. While all machine time is now utilized, it is possible that more or less than is desired of one item might be produced. Such unbalances can be eliminated by correcting the solution matrix for the next month.

The assignments can be checked to make sure that all items have been produced in the quantities required by multiplying the hours allocated in the solution matrix (Table 6) by the corresponding number of items which can be produced per hour (Table 3). As shown in Table 7, all orders have been filled in the required amounts except Item C, which has an overrun of 940 pieces. This overrun, however, is well within the 5 per cent allowable.

A computational method will prove that the assignments have been made in an optimum manner. The first requirement is that the total number of assignments equals the number of items plus the number of machines, less one. The reason for this lies in the theory of linear programming and is beyond the scope of this paper. In this example, 6 items plus 4 machines minus 1 equals 9, and there are 9 work-to-machine assignments in the solution.

Once this check has been made, Table 8 is constructed to show the number of pieces which

can be produced per machine per hour. This is a duplicate of Table 3. In addition, the locations on the table corresponding to the actual assignments are encircled to set them apart from the others. Assignments of Item C are also encircled here to set assignments apart from nonassignments. Hour allocations were not encircled for Item C assignments in the solution matrix (Table 6) merely as a quick visual aid, indicating that no one machine filled the entire order for C.

Arithmetical computations are made as will be described below, and when the results of these computations give a negative value to all of the work-to-machine assignments which could have been made but were not, the solution is an optimum one.

In positively or negatively identifying the table locations, rectangles are drawn having as corners one of the locations to be identified and three locations representing actual assignments. For example, to calculate 1A, a rectangle is created utilizing 1A, 1C, 2C, and 2A. A scratch-pad table is then made up with two columns labeled plus and minus. Corners of the rectangles are next alternately labeled (+) and (-), starting with the location being evaluated as (+). Plus values are entered in the (+) column and (-) values in the minus column. The columns are then added and the highest value indicates whether the corner being evaluated is negative or positive. In this case the sum of the minus column

Table 7. Solution Analysis

Machine	ITEM						Total
	A	B	C	D	E	F	
1	...	...	26,720	64,000			90,720
2	50,625	...	63,000	...	176,400	...	290,025
3	...	87,500	29,820	...	...		117,320
4	...	...	7,400	...	...	54,000	61,400
Total	50,625	87,500	126,940	64,000	176,400	54,000	560,065

Table 8. Proof of Solution.

Machine	ITEM					
	A	B	C	D	E	F
1	- 778	- 705	(668)	(800)	- 684	0
2	(2025)	- 1310	(1800)	- 1920	(2205)	- 994
3	- 1110	(1250)	(994)	- 960	- 1152	- 1028
4	- 825	- 847	(740)	- 720	- 765	(780)

is $2025 + 668 = 2693$ and the sum of the plus column is $778 + 1800 = 2578$. Therefore, 1A is marked with a minus sign to indicate that the location has been checked. Several rectangles are indicated on Table 8 to show the various construction possibilities.

Should any location calculated be plus, then the solution by inspection is not optimum. An optimum solution is obtained by reassigning some of the work. If the solution matrix is not overly

large, this may be done by trial and error. However, there is a procedure which can be followed in reassigning work to obtain an optimum solution and this may be referred to in works on linear programming and operations research.

In some instances it may be impossible to form rectangles in identifying table locations and in this case a "stepping-stones" technique is used in which polygons are formed. This also is covered in references on the subject.

Honing of Stacked Parts Boosts Production and Cuts Cost

"Horizontal stack-Microhoning" is a process developed by the Micromatic Hone Corporation, Detroit, Mich., to improve the quality of honed surfaces while reducing equipment and abrasive costs. With this method, several parts are stacked adjacent to each other and honed as though they were one long part. The process has been developed primarily for cast iron and soft steel, and is applied most effectively to short parts.

An example of horizontal stack-Microhoning to the finishing of seven rocker arms at a time is seen in the accompanying illustration. An average of 0.0015 inch of stock is removed from each bore, which measures 0.783 inch in diameter

by 7/8 inch long. The total cutting cycle is about fifteen seconds, which means that one part can be produced about every two seconds. Although size is held to 0.0003 inch, a closer tolerance could be held if necessary. Straightness and roundness are maintained within 0.0002 inch.

The guided type tool employed for this application uses plastic guides to position each part properly before the stones pass through. Parts are allowed to float between parallel plates in the fixture. By using stones about four times the normal length, greater abrasive economy and more parts between stone changes are realized. Abrasive life is over 1000 parts per set of stones.

An air gaging system is an integral part of this application. With each stroke of the honing tool, an air cylinder moves a gaging plug into measuring position within the rocker arm seen at the left of the stack. This is done only after the bore has been honed to a predetermined minimum size.

Setup for horizontal stack-Microhoning of seven rocker arms at one time. Plastic guides on the honing tool position the parts before the stones pass through.



BIG BELL FURNACE

Brazes missile assemblies

Missile-engine manufacturer uses huge bell type furnace to braze stainless-steel thrust-chamber assemblies in a hydrogen atmosphere. Gantry crane handles furnace components during operation

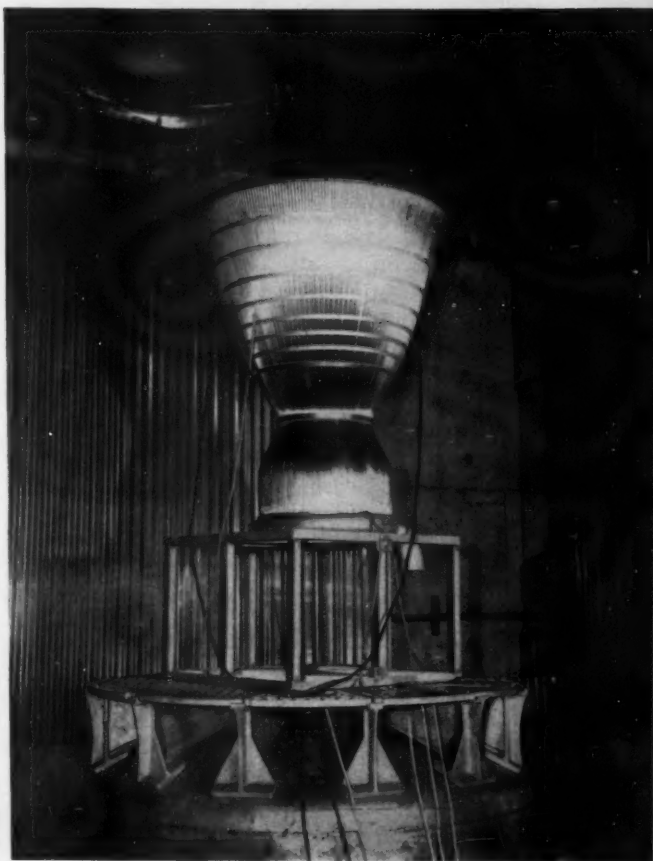
PAUL MEADOWS, Production Engineer
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AN ENORMOUS bell type furnace enables the Aerojet-General Corporation, Sacramento, Calif., to braze large stainless-steel assemblies for America's missile program. Built by the General Electric Co., the furnace, with heating bell in place, is approximately 17 feet high and is designed to enclose assemblies in a pure hydrogen atmosphere while brazing with high-temperature alloys. In Fig. 1, a thrust chamber for the engine of an Air Force Titan intercontinental ballistic missile is shown being lowered into position in the furnace pit prior to brazing.

The installation consists of the furnace members and an atmosphere supply and control system. The basic furnace components are a heating bell, two load supporting bases, a standby base, a retort, a cooling hood, a gantry crane, a temperature control panel, and a vacuum system.

As seen in Fig. 2, the heating bell is a movable steel unit which is lowered over the retort containing the assembly to be brazed. This bell is lined with brick and contains heating elements consisting of looped 1/4-inch molybdenum rods capable of producing and maintaining high temperatures. The bases are heavy steel plates used to support the load, retort, and heating bell during the heating cycle. They are provided with the clamping, cooling, and sealing equipment necessary for operation.

The retort (Fig. 3), a smaller bell-shaped member, isolates the atmosphere surrounding the work both from the atmosphere used in the heating bell during brazing cycle and from air during cooling. A cylindrical steel hood prevents excessive heat radiation and accelerates cooling of the



parts. In operation, the cooling hood is lowered over the retort after removal of the heating bell. Cooling is accomplished by a fan and two water-spray rings located near the top of the hood. These rings direct the spray water over the top of the hood and down the sides to a collection trough at the base. The cooling hood is shown in operation in Fig. 4.

All major components of the furnace are moved with a specially built gantry crane which travels on tracks that extend along the full length of the pit. The crane is designed to lift both the heating bell and cooling hood simultaneously to minimize the time required for positioning the hood after brazing.

The furnace-temperature control panel regulates all electric power to the furnace. Saturable reactor and proportional control are used to off-

set the inherent characteristic of the molybdenum to offer greater resistance when heated and provide smooth, accurate control through both the heating and operating cycles. A vacuum system is provided for purging purposes. The atmosphere supply and control system consists of a rich "Exalene" producer, a lean Exalene producer, an argon supply, a hydrogen supply, and a flow control panel. The rich Exalene producer supplies a flammable protective atmosphere to the heating bell and a high-pressure storage system accumulates the gas during periods of low flow.

A lean Exalene producer and storage system supplies inert atmospheres to the retort and heating bell for normal and emergency purging. In addition, argon, an inert gas, is furnished to the retort and heating bell during these operations. Hydrogen, used as a brazing atmosphere in the retort, is passed through a "Deoxo" unit that combines any free oxygen in the hydrogen gas with hydrogen. The resulting water is then removed by a hydrogen dryer. A flow control panel serves to regulate and control all gas flow to and from the retorts and heating bell.

Many safety and warning devices protect operating personnel and prevent damage to the furnace. Gas-flow or electrical-power interruptions, for example, are signaled by both auditory and

Fig. 1. Gantry crane operator is guiding an assembled thrust chamber for a Titan missile engine into the furnace pit prior to brazing.

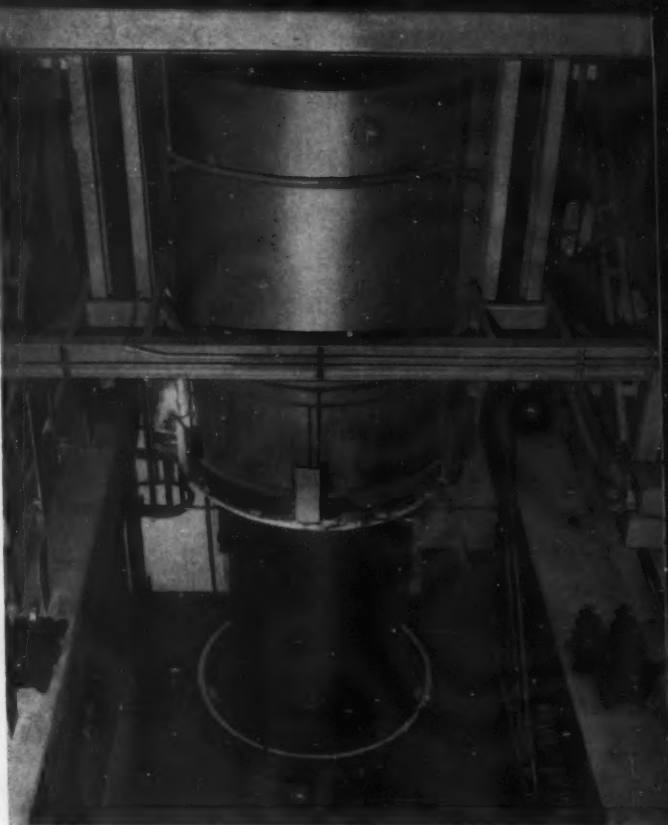


Fig. 2. Here, the huge heating bell is being lowered onto a work base and over the retort bell which had been previously placed over the thrust chamber.

visual mechanisms which also indicate the trouble location. A safety interlock system, built into the flow control panel, insures against improper gas flows.

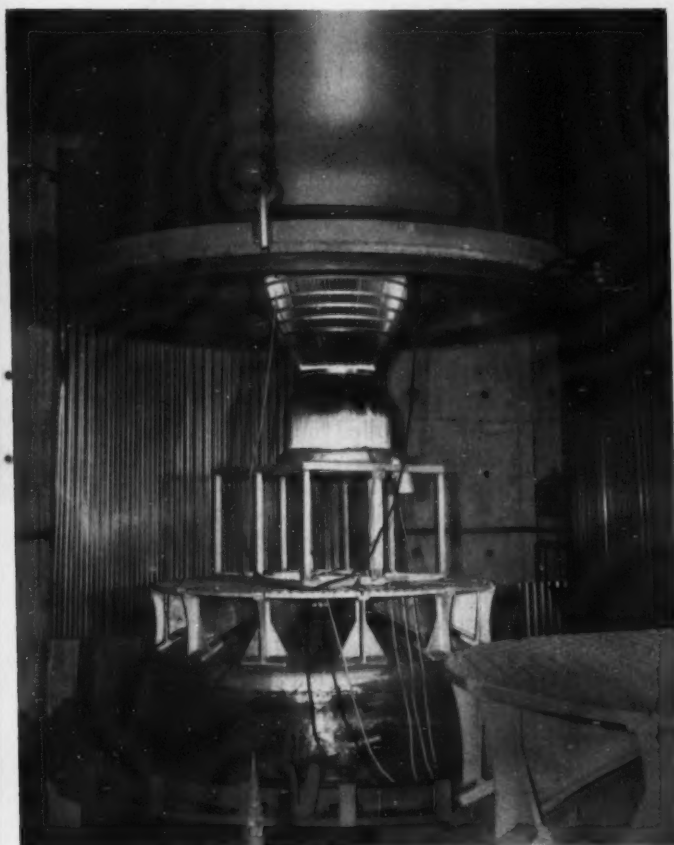
Still another safety feature is an intercommunications system between all operators of the furnace. Sound-powered head phones are used to relay information to a central point where all operations to be performed are checked against a master list.

While actual furnace operation varies with the type of work being processed, the brazing cycle usually starts by placing the prepared assembly on the load support base. A prepared unit is pre-assembled with simple clamps or light tack welds and has the braze alloy in position. Thermocouple connections are then made to multiple-point strip-chart recorders which provide a record of time and temperature variations as the unit is brazed. Such charts are later studied and used to improve the process.

When the unit has been positioned, the retort is lowered over the assembly, locked into position, and evacuated. This is followed by the admission of dry, pressurized hydrogen. The heating bell is next picked up, lowered over the retort, and connected. The bell, at this stage, is pre-heated and contains an atmosphere of rich exo-

Fig. 3. (Below) The retort bell, shown being removed from the base, isolates the hydrogen atmosphere surrounding the work from that in the heating bell.

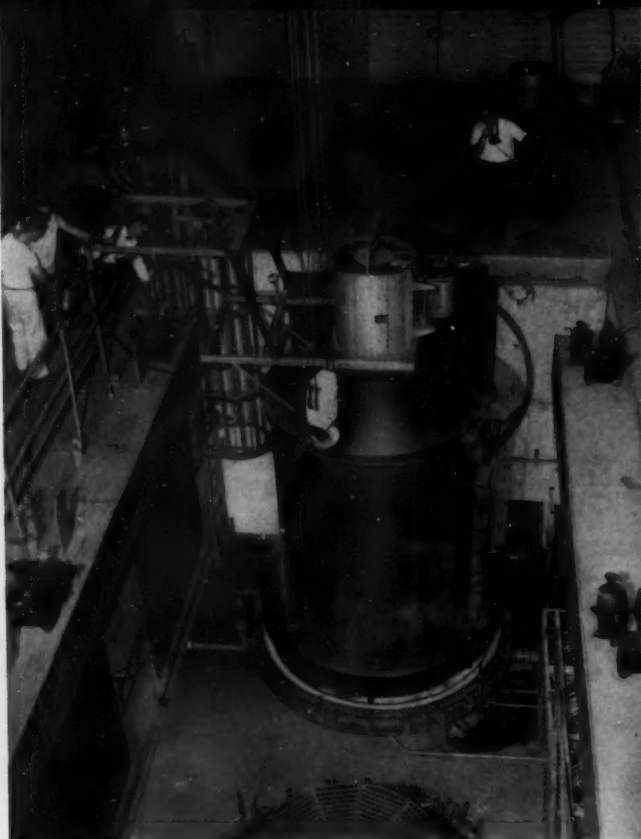
Fig. 4. (Right) Cooling hood equipped with a fan and water-spray rings in operation on a hot thrust chamber. The hood is quickly lowered over the retort after the heating bell is removed.



thermic or hydrogen gas which is maintained above the auto-ignition temperature.

The furnace is then brought to, and held at, the melting temperature of the brazing alloy for a short time. Following brazing, the heating bell is lifted from the retort and replaced with the cooling hood. The water sprays and fan are activated until the retort has cooled sufficiently, whereupon the hood is removed and the retort purged with inert gas. To permit loosening of the retort clamps, the retort is evacuated. The cycle is completed by removing the retort and assembly.

In the heading illustration, a thrust chamber is seen standing on the base after brazing. While a great deal remains to be done to determine the extent to which the unit can be used, Aerojet engineers expect the big furnace to materially improve brazing and effect significant time savings.



New Bright-Nickel Process

The "Superlume" bright-nickel plating process yields deposits which are exceptionally bright at high and low current density. It has the ability to level scratches to an extraordinary degree. The process was developed by Hanson-Van Winkle-Munning Co. It is simple to control and easy to operate.

The process is characterized by excellent tolerance to inorganic impurities such as zinc and copper, and the bath is amenable to continuous carbon treatment resulting in relative freedom from organic contamination. After original make-up, only two addition agents are used. One provides ductility, stress-relief, and tolerance to impurities. The second addition agent provides high brightness and leveling.

Conversion of existing baths to the new Superlume process is relatively easy. A gallon sample of existing baths should be sent to the H-VW-M laboratory for exact conversion instructions.

Agitation of the Superlume solution has a beneficial effect in producing bright, smooth, uniform deposits. Means of agitation may be provided by conveyor motion, mechanical agitation, cathode rocker, or air agitation. The latter is preferred because it makes for greater deposit uniformity. A still-bath variation is available.

High-Production Milling on Small Machines

BICYCLE coaster-brake shoes are being machined in the plant of the Locke Machine Co., Cleveland, Ohio, on U. S. No. 1 milling machines at a saving in time of 40 per cent over previous methods employed. These machines are equipped with automatic accessories to enable straddle milling, slotting, and other cuts at production rates up to 688 pieces an hour. Air-operated fixtures and vises are provided to facilitate locating and clamping of the work-pieces.

Two basic operations are involved in machining these coaster-brake parts—the milling of a 34-degree vee and the milling of two radius grooves. The parts are made from cold-rolled steel and dimensions must be held to the specified size within 0.003 inch.

The vee is milled in two passes by a high-speed slitting saw in the setup shown in Fig. 1. The cutter is 3 inches in diameter by 1/8 inch wide and runs at a speed of 200 rpm. The cylindrical work-piece is held as shown in a swiveling type of fixture, which is equipped with an air-operated locking device. Placement of the part in a V-block cradle automatically lines up the part with a locking plunger.

After the operator has loaded the part and locked it in place, he moves the swivel fixture to the left and then pushes a handle to start the hydraulically operated table through its cycle for milling one side of the vee. At the end of this

cycle, the fixture is swiveled to the right and the cycle is repeated for milling the opposite side of the vee.

To remove the part from the fixture, the operator presses an air valve with his left hand. At the same time, with a new part in his right hand, he displaces the finished part by striking it lightly. As the finished part slides down a chute, the operator places the new part in the fixture, ready to be milled. The production rate in this two-pass operation is 231 parts an hour.

In the second operation on the coaster-brake shoe, which is illustrated in Fig. 2, two radius grooves are milled simultaneously by high-speed steel cutters 2 1/4 inches in diameter by 3/16 inch wide. These cutters have their peripheries contoured to suit the rounded grooves that they cut. Again, the work-piece is clamped in an air-operated fixture. The shoe is locked in a cradle of this fixture from the vee milled in the first operation. This work fixture is operated automatically by the hydraulically actuated table. Thus, the fixture closes when the table cycle is started and opens as the table returns to its starting position. The arrangement leaves both hands of the operator free for loading and unloading work.

These milling cutters run at a speed of approximately 200 rpm. They are supported by a heavy over-arm. The production rate is 688 pieces an hour at an efficiency of 100 per cent.

Fig. 1. Small-size milling machine set up for the machining of a V-slot in bicycle coaster-brake shoes at a production rate of 231 parts an hour.

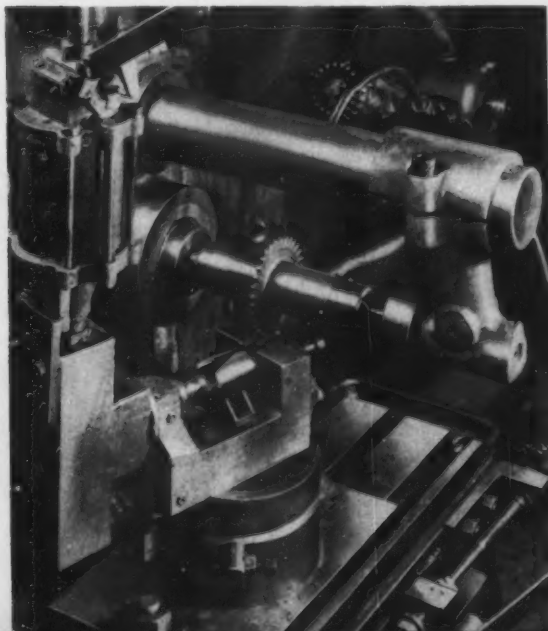
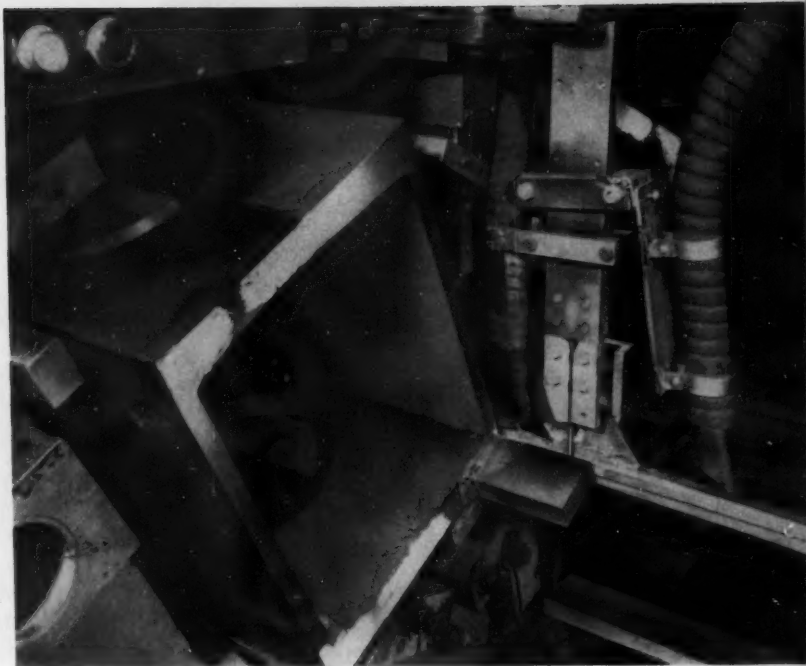


Fig. 2. Second operation on the coaster-brake shoes, which consists of milling two grooves axially on the outside cylindrical surface.



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Diesel Engine Skeleton Is Unusual Weldment

CRANKCASE SKELETONS are among the large weldments being fabricated on a production basis in the Chicago plant of the Electro-Motive Division, General Motors Corporation. They are built for V-type diesel locomotive engines having six, eight, twelve, or sixteen cylinders. The skeletons do not include cylinder liners and many other parts that are added after delivery to the division's La Grange, Ill., plant. There, most of the machining is done, and the engines are assembled and installed in various types of power equipment built in the same shops.

As can be seen in Fig. 1, the skeleton crankcase includes two box-section girders set at a vee angle. Each girder is, itself, a weldment—the two being joined by a long weld at the bottom of the vee and by a tie-plate at the top. Below the two box girders (which provide most of the longitudinal stiffness) are special longitudinal support angles to which the oil-pan will be bolted. One of these angles is welded to the lowest edge of each girder and also to one arm of each of the forged supports for the upper main crankshaft bearings.

Large holes are cut in the girder walls, those

in the top faces being for cylinder-head retainers. Formerly, these sleevelike retainers were forged, but now they are formed from bar stock of special tapered section and the joint is arc-welded. A side opening is then flame-cut in each retainer to receive an exhaust elbow. After the retainers have undergone some machining, an exhaust elbow is arc-welded into the flame-cut hole and the sub-assembly is hand arc-welded into the corresponding upper box-girder hole. This brings the top ends of the exhaust elbows in each row into a plane for connection to an exhaust manifold. Other components are welded in place at the top of the skeleton before the whole assembly is stress-relieved.

From the foregoing it can be seen that the skeleton is a complex weldment involving many elements, and that it constitutes the main framework of the engine. It is not an easy assembly to build, as many dimensions must be held within close limits to insure proper alignment and fit with mating parts.

Necessary precision is attained, however, partly by using adequate fixtures and partly by following welding procedures designed to mini-



mize warpage. Wherever feasible, welding sequence is selected so that any warpage caused by one weld is offset by a counteracting tendency in the next or subsequent welds. Fixtures are heavy and are designed to provide proper part location and to help minimize warpage. Occasionally some flame-heating is needed to correct warpage that has occurred despite due precautions.

Several weldments used in the crankcase skeletons involve unusual procedures and the assem-

bly as a whole is deserving of study. The locations of some major welds are indicated by arrows in Fig. 2. Wherever feasible, automatic submerged-arc welds are employed and are produced in one pass. This practice avoids some uncertainties associated with multiple-pass work, such as interpass cracking and hand chipping to remove slag and flux between passes.

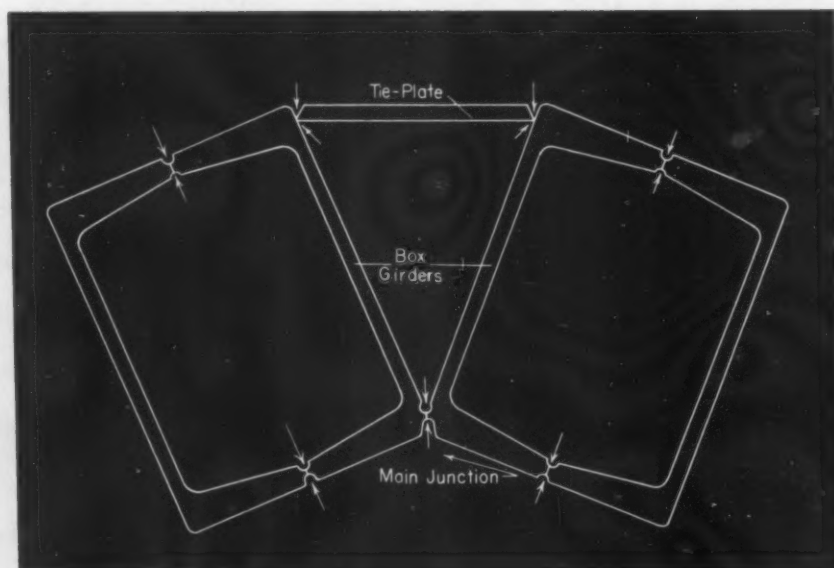
Each box section is produced from two lengths of channel that has been rolled to a special sectional shape. Edges to be joined are milled to form U-shaped grooves at each side for the weld beads. After tack-welding of the mating pairs of channels and the addition of runout plates at each end, one unit at a time is set in the fixture shown in Figs. 3 and 4, and grounding clamps are attached. This fixture rests on rollers supported on a carriage that moves along a track at welding speed when producing internal weld beads. After the first of these is completed, the fixture is rotated 180 degrees on the rollers and the opposite internal bead is laid down.

Both illustrations show the automatic welding head. It is attached to the end of a boom of sufficient length to accommodate the longest box girder. A fixed support holds the boom and head at the correct height. The head remains stationary within the box girder as the latter is advanced on the carriage at a welding speed of 14 ipm (inches per minute). Before each weld, which is completed in one pass, a hopper attached to the head is filled with enough flux to cover the entire bead.

Flux is fed in the usual way, and that remaining unused is picked up by a suction tube running along the boom. It passes to a vacuum tank

Fig. 1. (Above) View of the end of an unusual weldment. This assembly is the skeleton of a sixteen-cylinder diesel engine being produced especially for use in locomotives.

Fig. 2. (Right) Several components of the engine skeleton are here illustrated. Arrows indicate where long, straight-line welds are made by automatic, submerged-arc type machines.



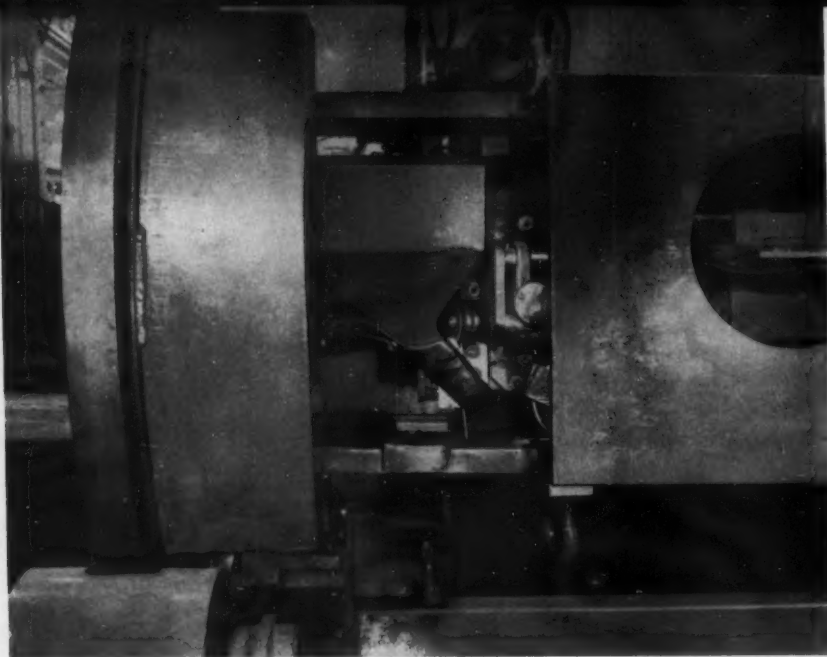


Fig. 3. (Left) Portion of the fixture and boom head employed to make internal longitudinal welds in the box girders. Head is stationary, work and fixture are traversed.

Fig. 4. (Below) Another view of setup shown in Fig. 3. Fixture rings rest on rollers and can be turned 180 degrees to make the second internal weld.

where fines and particles of slag are separated out, the remainder of the flux being re-used. Wire of 5/32-inch diameter feeds first from a reel on the boom support, then through an insulated tube along the boom, and finally, into the feed mechanism of the head. Welding is done at about 37 volts, giving a current of 700 amperes.

After the two internal seams are completed, the box girder is transferred by conveyor to the welding machine shown in Fig. 5, which has a carriage fixture similar to that used for the internal welds. Carriage motion is set for a higher welding speed—15 ipm—although the U-groove to be filled is 9/16 inch deep, as against 5/16 inch deep for the internal grooves. This high rate is made possible by using two Lincoln Electric LAF heads at the same time.

The heads are set close together in tandem arrangement, Fig. 6. Two simultaneous arcs are produced, one with 7/32-inch-diameter wire and the other with 5/32-inch-diameter wire. Alternating current is used for the larger, and leading, electrode that fills the lower portion of the groove, and direct current for the second, and smaller, wire that fills the remainder of the groove, producing a slight crown. Direct current is employed to provide better surface finish. Although a dual bead is produced, the electrodes are only 1 1/2 inches apart so there is, in effect, a single pool of weld metal covered with flux. Consequently, a single bead rather than a double one (such as would be obtained if two separate passes were made) is produced.

In this machine, the heads are fixed and the work is traversed below them along with an air clamping fixture. Flux feed is rapid enough to keep both arcs covered and there is a vacuum pickup for unfused flux. Wire is fed from sepa-

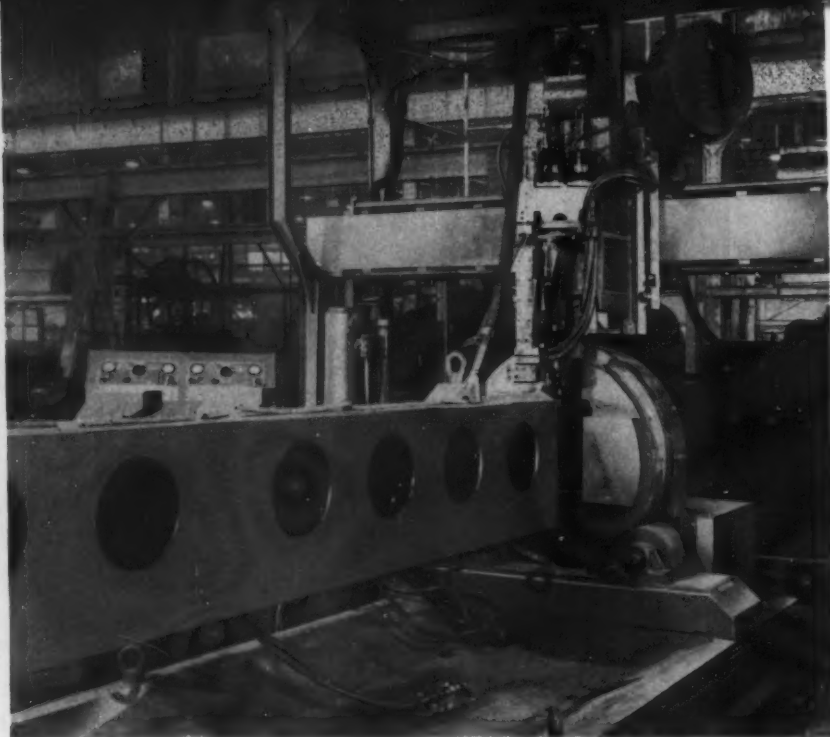
rate reels, but the rate of feed is adjusted to maintain constant arc length. Any bowing of the weldment caused by the first outer bead tends to be corrected when the duplicate bead is produced on the opposite side. To do this, the weldment is turned over on the carriage rollers without being removed from the fixture.

When each pair of box girders has been welded, they undergo some planing operations to provide U-shaped grooves for beads that are to join the two at the bottom of the engine vee. Considerable flame-cutting also is done to provide rows of circular holes, many of which can be seen in Fig. 1. Some holes cut across the longi-



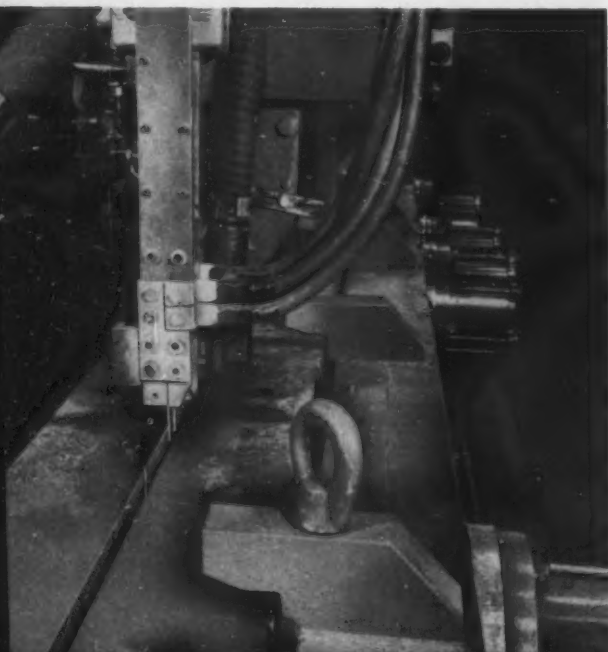
Fig. 5 (Right) Two automatic heads arranged in tandem make external welds on box girder. Mounting of fixture on rollers simplifies turning the girder for second weld.

Fig. 6. (Below) Close-up of the welding heads seen in Fig. 5. The ends of the two electrode wires can be seen (center) above the slot for the weld bead.



tudinal welds, but others are through the webs of the channels.

Following this preparation, a pair of box girders is clamped in the fixture partially shown in the heading illustration. It is part of an automatic submerged-arc welding machine that produces the joints in the vee of the skeleton. This Lincoln head travels at a rate of 9 ipm and uses a single electrode with a 750-ampere welding current. Subsequently, but in another machine, this same assembly (to which some parts have been added) is turned over and the bead on the other side of the groove is produced.



Although a strong joint results, longitudinal stiffness of the assembly is greatly increased by the tie-plate (Fig. 2) that joins the tops of the two box sections. Before the tie-plate is added, however, one of much lighter gage is welded a few inches above the bottom of the vee, forming the top wall of a duct for lubricating oil that is fed to the crankshaft, and other bearings. Both edges of the heavy tie-plate are beveled before it is tacked in place.

Two submerged-arc welds along the inside edges of the tie-plate are made in a boom welder similar to that used for the inside welds of the box girders (Fig. 3). Then, the weldment goes to a machine of the general type shown in Fig. 5 but having two separate carriages, each with its own head. These heads are used simultaneously, each electrode laying down one of the two parallel weld beads on the outside of the tie-plate. This procedure helps to reduce distortion. In addition, labor costs are lowered, since one man can tend both heads.

The operations described do not complete the crankcase skeleton, but cover most of the automatic welding. There remains, of course, considerable hand welding, some of which is expedited by using rods having iron-powder coatings. Hand welding, including that done to join the cylinder retaining sleeves to hole peripheries in the tops of the box sections, is facilitated by putting the main weldment into a ring fixture that rests in tracks. It is then easy to rock the fixture about its axis to bring areas to be welded into advantageous positions.

TAPPING NUTS

At rates up to 100,000 per hour

TAPPING of up to 100,000 nuts per hour is possible with a single multiple-spindle machine developed by Zagar, Inc., Cleveland, Ohio. Five of these automatic machines are now undergoing exhaustive tests in various industrial plants, and preliminary reports indicate their success. While conventional tapping machines are usually equipped with only a single tap, these machines are provided with multiple-spindle heads that can carry from 24 to 100 taps, depending on their size.

As shown in Fig. 1, the new machine consists essentially of a vertical, multiple-spindle head; a rotary indexing, work-holding plate; and a hopper feeding unit. The same basic machine can be

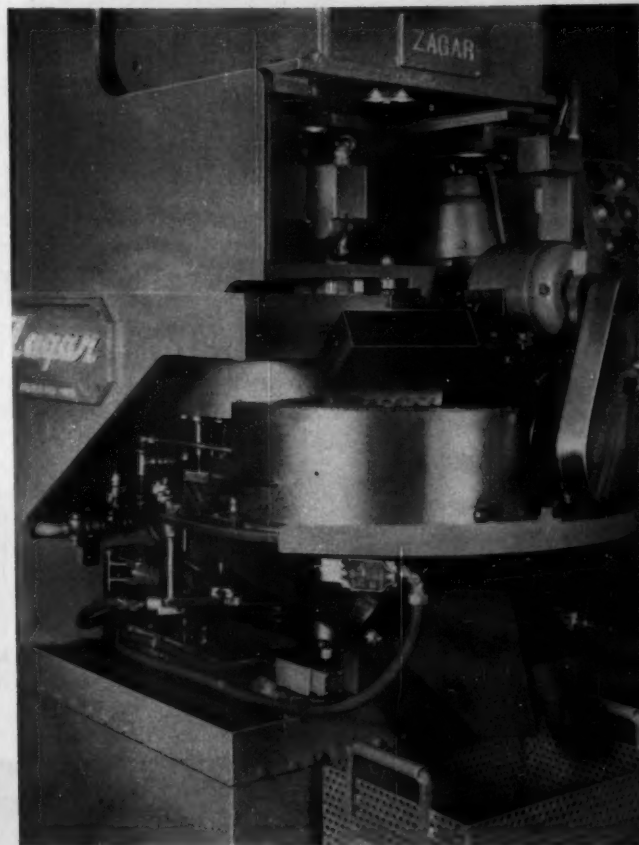


Fig. 2. Nut blanks drop from chute-loaded hopper into hexagonal-shaped cavities provided in the rotary indexing, work-holding table.



Fig. 1. Multiple-spindle automatic machine permits tapping up to 100,000 nuts per hour. Heads can accommodate from 24 to 100 taps.

provided with any one of five multiple-spindle heads: a 100-spindle head for tapping nuts up to No. 10-32 thread size, an 80-spindle head for nuts up to 5/16-inch thread size, a 60-spindle head for nuts to 3/8-inch size, a 50-spindle head for 9/16-inch nuts and smaller, and a 24-spindle head for nuts having a 1-inch thread size or less.

While calculations showed that a 40-hp motor would be required to tap 100 nuts having 3/8-16 threads, it was known that the energy is required for only a short interval of time—actually about one-third of the tapping cycle. By providing the machine with a flywheel, it was found that ample torque could be supplied from a 10-hp motor, and this size motor is now standard on all machines.

Fig. 3. Multiple-spindle head can be tilted upward at an angle of 30 degrees by means of an air-cylinder-actuated mechanism.



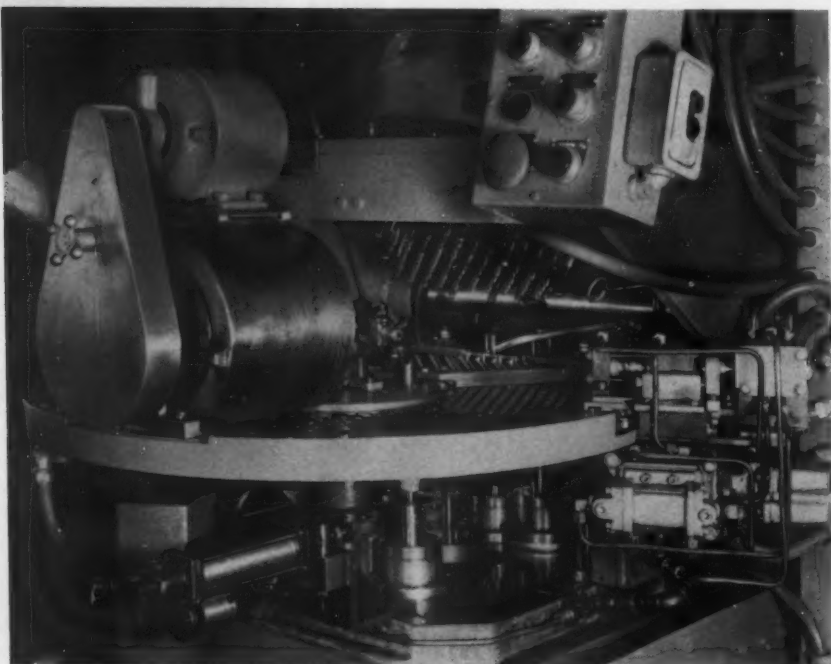
Raising and lowering of the work-holding table during tapping is accomplished by three lead-screws. Shock-resistant, electromagnetic clutches are provided for smooth reversing of the taps.

One of the major problems that had to be overcome in developing this new concept of threading nuts was a means of handling (including proper positioning and holding during tapping) up to 100,000 nuts per hour. A survey of the field showed that the fastest automatic hopper available would only handle 10,000 nuts per hour. The solution was the design of a basically simple feeding unit.

A sheet-metal hopper, Fig. 2, into which nuts are poured at random through a chute, is mounted over the circular indexing, work-holding plate that contains 100 hexagonal-shaped cavities. It was found, by reason of probability, that approximately 30 per cent of the cavities became filled with properly oriented nuts. By vibrating the plate and agitating the supply of nuts, the plate could be approximately 100 per cent filled in only five seconds. A motor-driven wire brush, 8 inches in diameter by 6 inches wide, mounted at an open end of the hopper, helps to agitate the supply of nuts, and keeps the surface of the plate clear by throwing nuts that are not properly oriented in the cavities back into the hopper.

Precision tapping of Class 2B and 3B threads is made possible by the use of accurate lead-screws. Tap breakage has been no problem, primarily because of using adequate amounts of

Fig. 4. Taps can be changed quickly since they are only retained by spring-loaded friction type tool-holders.



the proper coolant; the correct type taps; carefully selected and clean blanks that are free of any foreign material; conservative tapping speeds; and accurate alignment and proper holding of the work-pieces.

Careful investigation showed that taps purchased from all of the reputable manufacturers are consistently being made to a high degree of quality, both in workmanship and material. Carbon-steel taps have been found satisfactory for stamped nut blanks, but for cold-headed nuts, high-speed steel taps with a black-oxide finish are desirable. While the taps on single-spindle machines operate at speeds of 2000 rpm or more, the speeds for multiple-spindle tapping are maintained between 250 and 1000 rpm—with an average cutting speed of 60 surface feet per minute. The lower speeds reduce the amount of heat generated, permit better coolant distribution, and result in longer tool life.

Quality of the tapped nuts is maintained by removing and visually inspecting the taps after two or three hours of operation. This has been found more effective than checking the nuts. When chipped-out threads are detected on any tap, it is immediately replaced. A good indication

of when the taps require sharpening is obtained from the torque load imposed on the machine motor. When the ammeter readings rise, it is a sign that all of the taps should be removed and resharpened. An inspection device is being developed for use with the machine which will automatically inspect every nut tapped in each one-hundredth cycle, and will shut off the machine if any poor-quality threads are detected. Little evidence has been found of nuts being produced with no threads or defective threads.

The machine has been provided with a push-button-operated, air-cylinder-actuated mechanism that pivots the multiple-spindle head upward through an angle of 30 degrees, as seen in Fig. 3, to facilitate changing the taps. Specially designed tap-holders retain the tools by means of springs and a slight amount of friction, and the taps can be changed in a matter of seconds merely by pulling them out of their holders (Fig. 4).

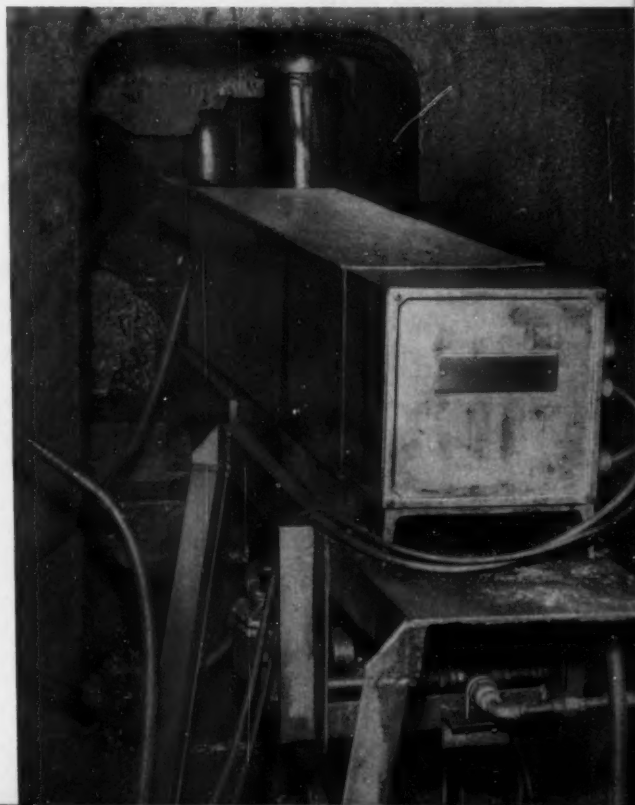
An 80-spindle head is mounted on the machine illustrated, and it is set up to tap nuts having 5/16-18 threads at the rate of 40,000 per hour. To change over to the production of a smaller-size nut, it is only necessary to replace the lead-screws, taps, and work-holding plate.

Lubricating Forging Dies

Lubrication of dies used for forging front steering knuckles at the Buick Motor Division, General Motors Corporation, Flint, Mich., has been facilitated by means of the air-operated device shown in the accompanying illustration. Four of the units, made by the Columbus Automatic Lubrication Co., Columbus, Ohio, are now in use at the Buick plant on 2500- and 3000-ton capacity forging presses.

When actuated by a foot pedal, an arm on the special lubricator is traversed between the dies and lubricant is sprayed on both the upper and lower dies. The rate at which the arm is traversed and the time of spraying are adjustable. Also, the compact unit is electrically interlocked with the press so that the press ram cannot be lowered until the arm is withdrawn from between the dies. Less lubricant is used than when it was formerly applied with a manually operated spray gun, and little maintenance is required.

Air-operated, automatic lubricating device sprays both upper and lower dies in this forging press.



WIDE-RANGE AIR

Measurements of up to 0.020 inch or more are possible using air gages equipped with a new nozzle and pressure indicator. This type of gage provides a wide range, minimum hysteresis, and good linearity

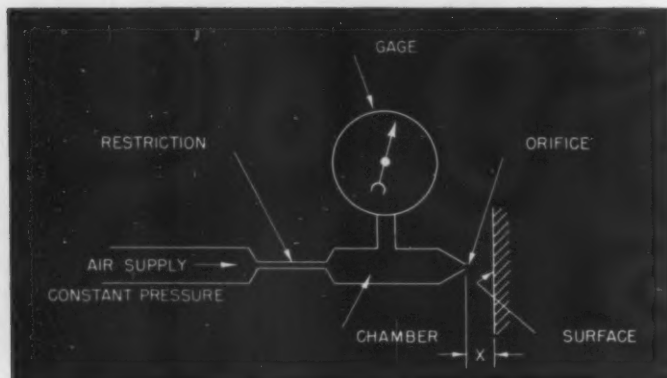


Fig. 1. In this type of conventional air gaging, the back pressure developed in chamber is a function of dimension (X).

AIR GAGING is being widely used for the comparative measurement of dimensions because of its sensitivity, stability, simplicity, and ruggedness. The sensitivity of such gages permits fine measuring, and the stability insures reliable repeat reading. Simplicity and ruggedness minimize the maintenance requirements for such gages.

In one conventional type of air gaging, Fig. 1, air is fed through a restriction into a chamber, and exhausted through an orifice against the surface to be measured. The back pressure developed in the chamber is a function of dimension X —the pressure varying with distance from the orifice to the surface. The pressure in the chamber is indicated on a gage calibrated in thousandths of an inch to provide a direct reading.

Typical of the curves obtained when plotting the back pressure against dimension X with such an arrangement is the one seen at A in Fig. 2. To obtain curves having long sections that approximate straight lines—which means that the indicating gage can have a linear scale over a long range—the B. C. Ames Co., Waltham, Mass., has developed a new nozzle and pressure indicator. Curves B through G were obtained with air gages having these units. Such gages can be used for measurements of up to 0.020 inch or more.

While the new nozzle, shown diagrammatically in Fig. 3, is similar to the conventional type illustrated in Fig. 1 in that it delivers a back pressure,

it may be more properly considered a flow meter. Air at constant pressure passes through the small annular space around a tube and out the orifice. The back pressure developed in the tube is transmitted to the gage. If dimension X is very large, maximum air flow occurs through the nozzle. In such cases, the high-speed air acts as an aspirator and the gage will show a negative pressure or suction. This explains the large ranges possible, as indicated by curves B through G in Fig. 2. Differences in the curves obtained are the result of dimensional changes in the nozzle—mainly the size of the hole. The actual orifice does not have to be integral with the main parts of the nozzle, and may be extended by means of flexible tubing to permit gaging in difficult or remote locations.

On the pressure indicator, Fig. 4, all moving parts are spring-suspended to minimize hysteresis. Pressure enters the thin neoprene bellows which acts as a spring-loaded piston. The piston is supported through a rod by parallel spring reeds. Motion of the piston is converted to angular motion of the pointer by the hand reeds attached to the pointer.

By suitable choice of the component dimensions, it is possible to make an indicator of this type so that full-scale deflection of the pointer will be caused by a pressure change of as little as 2 psi. For example, the indicator of the air gage used in obtaining curve B (Fig. 2), which has a slope of about 60 psi per 0.001 inch, deflects full

GAGING

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B. C. Ames Co., Waltham, Mass

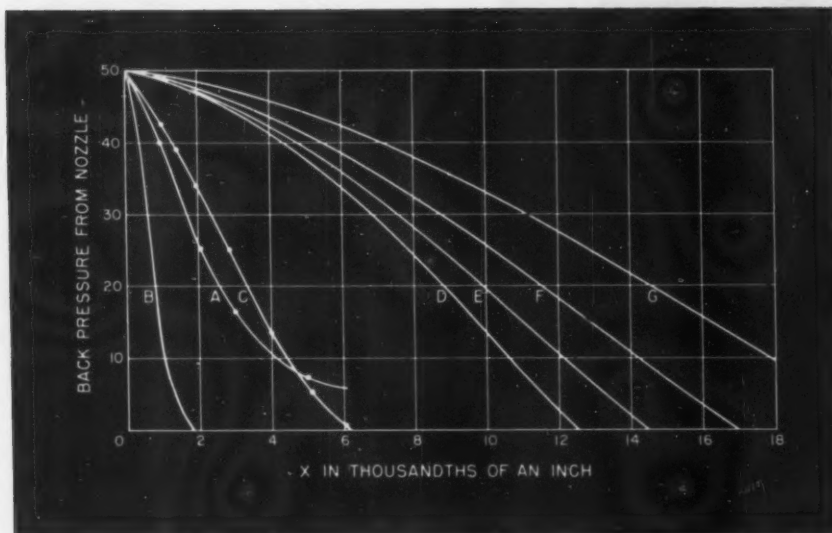
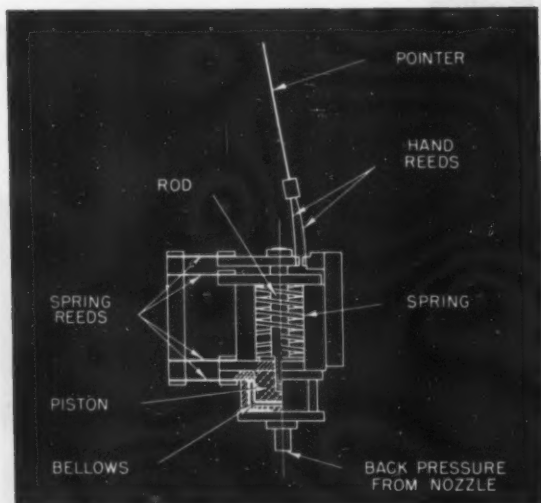
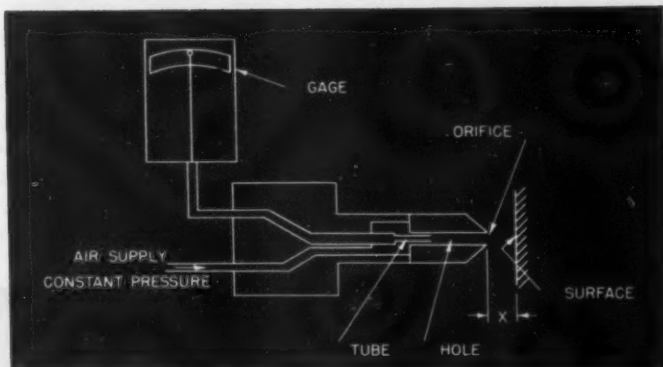


Fig. 2. Curve (A) was obtained with an air gage of the type shown in Fig. 1, while the curves (B) through (G) were obtained with type seen in Fig. 3.

Fig. 3. With this type air gage, the nozzle acts as a flow meter. When dimension (X) is large, air acts as aspirator and gage shows negative pressure.

Fig. 4. Moving parts on this pressure indicator are spring-suspended to minimize hysteresis. Neoprene bellows acts as a spring-loaded piston.



scale with a pressure change of only 2 psi, and the full scale represents a dimension X of 0.000030 inch. However, such sensitivity is seldom needed, and the indicators are more commonly calibrated with a full scale of 0.0001 inch—which permits reading to 0.000001 inch. Also, much less sensitivity is obtainable by using other nozzles and stronger springs in the indicator. Standardization of the gages can be accomplished with a single master because of the long linear range of the system.

Gaging Holes

Flow of air through holes only a few thousandths of an inch in diameter is so slow, even at high pressures, that the response speed of flow-method type gages is also slow. Another

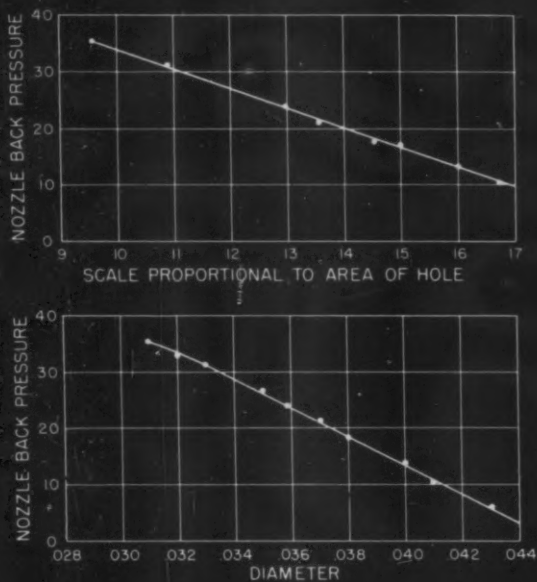


Fig. 5. Straighter line is obtained when plotting back pressure against area (as seen at top) than when plotting against diameter (bottom).

ting of the indicator can be varied over a wide range, and the bucking pressure can be set at different values. This method has been used to measure the small clearance—in the order of 0.000010 inch—between a tiny shaft and the jewel bearing in which the shaft rotates.

For holes from approximately 0.010 to 0.040 inch in diameter, the flow of air through the holes is of sufficient magnitude that it can be measured by the nozzle. However, the nozzle orifice should be larger than the hole so that the hole offers the main resistance to flow. When the back pressure from a nozzle is plotted against the hole diameter, the curve obtained is nearly straight, as seen at the bottom in Fig. 5. However, when the same data is used to plot the pres-

method that is faster consists of measuring the time required for a given drop in pressure, in a system in which the only loss of air is through the hole. Even faster speed can be obtained by using a differential indicator. With this system, two similar units are used, one bucking the other, with the bucking pressure being obtained from a separate regulator. In this way, the zero set-

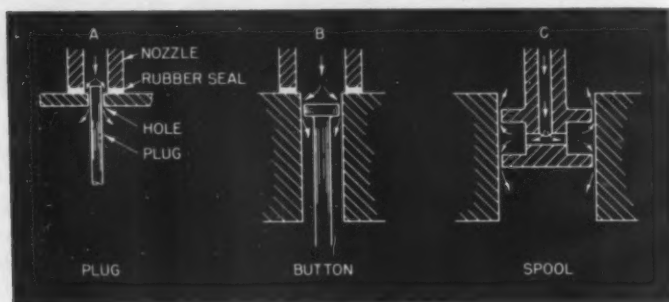


Fig. 6. To reduce excessive air flow, gage can be provided with a cylindrical plug (A), a button-head plug (B), or a spool (C).

Fig. 7. "Finger gage" can be used to measure small or large holes, as well as outside dimensions, by using various fingers or fixtures.

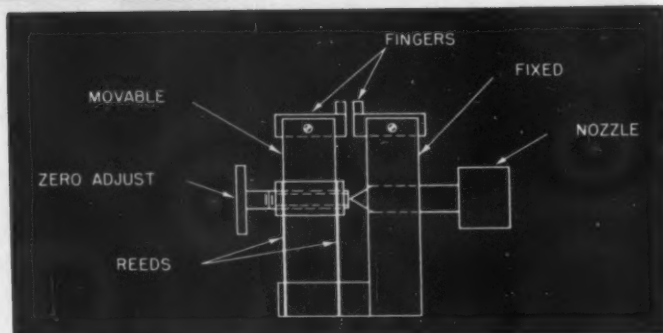
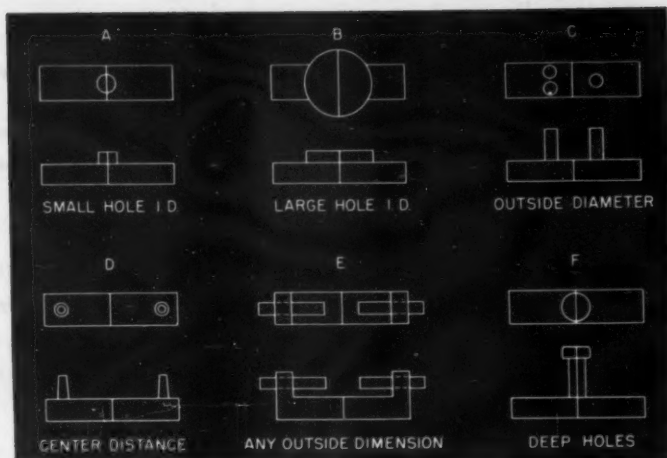


Fig. 8. Various type "fingers" which can be secured to the tops of the movable and fixed members of gage seen in Fig. 7.



sure against the cross-sectional area of the hole, the curve is straight, as shown at the top. This illustrates the linear relationship between flow and area, and also shows the considerable range in hole sizes that can be measured with one nozzle.

When the holes to be gaged are larger than 0.040 inch in diameter, the air flow rapidly becomes excessive. However, the flow can be reduced by inserting a cylindrical plug, as shown at A in Fig. 6. With this arrangement, the flow is determined by the annular space between the plug and the bore of the hole being gaged. This method is applicable to short holes, where the length has little effect on the measurements.

For longer holes, a button-head plug, as seen at B, is used to eliminate any errors that might be introduced by the lengths of the holes, and permit exploring long holes for taper. When the

holes to be gaged are approximately 1/4 inch or more in diameter, the air pressure on the top of the button head becomes considerable. This pressure can be eliminated by using a spool, as shown at C. As the hole size increases, the spool diameter must be made closer to the hole diameter in order to reduce the air flow. Spool type gaging heads having only a single-exit orifice can be used to measure out-of-roundness of holes.

The "finger gage" shown in Fig. 7 can be used to measure small, as well as large, holes. In this setup, the nozzle is held in a fixed member of the gage. A movable member, supported on spring reeds, carries a zero adjusting screw. Various type "fingers," or fixtures, such as the ones seen in Fig. 8, can be secured in grooves at the tops of the movable and fixed members. Fingers can be made for holes as small as 0.030 inch or less in diameter, as well as for large and deep holes.

Buffing Phenolic Plastics

Buffing wheels for phenolic materials are usually made of soft muslin cloth, with loose stitches widely separated. This allows the wheel to adjust itself readily to the contour of the molded surface and also provides better and more uniform cutting properties.

Abrasives such as tripoli, crocus, rouge, etc., are mixed with bonding waxes. These preparations are cast into convenient bars to simplify the application of the compound to the wheel surface. The bars are often called "sticks."

The terms "cutting" and "buffing" are commonly used in the plastics industry. The "cutting" operation is mainly used when the mold parting line is actually on an important surface and must be removed by sanding or filing. "Cutting" is

also used to remove scratches, or when an inferior surface must be taken off.

"Buffing" is used to restore the lustrous surface after handling the molded parts during finishing operations. In general, there is only the problem of removing finger marks, etc. This operation usually can be accomplished without the use of a buffing or polishing compound.

Wheel speed for "cutting" and "buffing" operations is an important factor. The best average peripheral speed is 6000 feet per minute. Too high a speed can cause difficulties, particularly on irregular contours where the high centrifugal force will not allow the wheel to form itself to the contour of the part unless great pressure is applied.

Why Not "TUMBLE" into Higher Profits?

Recent developments in precision barrel finishing have widened its application and made it an important and economical method of obtaining low micro-inch finishes. This article gives examples of how and when the process can be used to advantage

TODAY, selection of manufacturing processes to obtain low micro-inch finishes economically is not a simple task. While modernization and improvement of machines and methods have tended to lower costs, increases in overhead and labor rates have largely consumed the dollars saved. When a smooth finish is specified, it is important that the process engineer choose both the methods and sequence of operations which will impart the desired finish at a minimum cost.

Generally, a series of operations is necessary to obtain the required finish. Each operation, however, adds to the piece cost, especially those during the early stages of machining which produce the basic shape of the part. Repeated operations tend to multiply these costs.

In choosing a method to produce a low micro-inch finish, it is wise to consider the costs involved in machining the surface. In Table 1 the costs of reducing surface roughness in several machining steps are compared. Obviously "over-machining" parts is an expensive luxury.

When a fine surface finish is specified for machined parts that must be in intimate con-

ROBERT E. EARL, Technical Director
Roto-Finish Co., Kalamazoo, Mich.

tact, the prime purpose is to reduce friction and wear. For example, the surfaces of bearings and rotors which are to be operated under heavy loads should be smooth enough so that irregularities will not penetrate the lubricating oil film and permit metal-to-metal contact. The surfaces, however, should not be made so smooth that they will not hold or maintain an oil film and thus cause friction.

On self-aligning bearings, proper surface finish is more important than close dimensional tolerances. Close tolerances cannot be held if during the running-in period the surface irregularities of the bearings are worn off, causing a dimensional change. The relationship between different dimensional tolerances and the range of surface finishes suitable for working to these tolerances is given in Table 2.

The use of barrel finishing often results in savings both to manufacturers who employ succes-

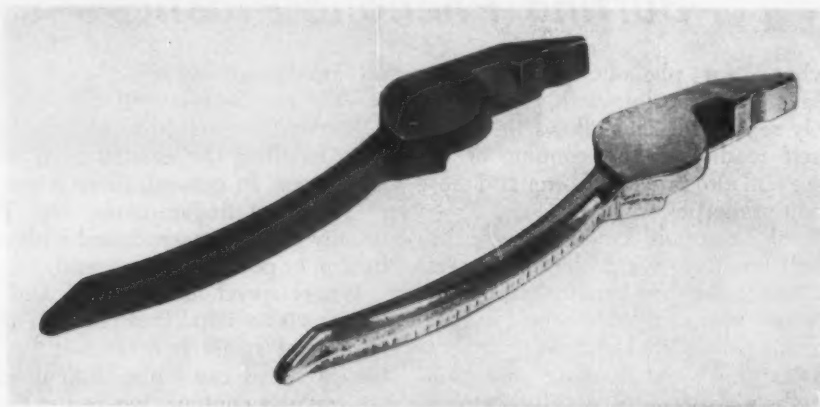


Fig. 1. Part for a sand-cast bronze plier before and after barrel finishing. Duration of process was unnecessarily long and costly due to deep marks left by previous belt-grinding operation.

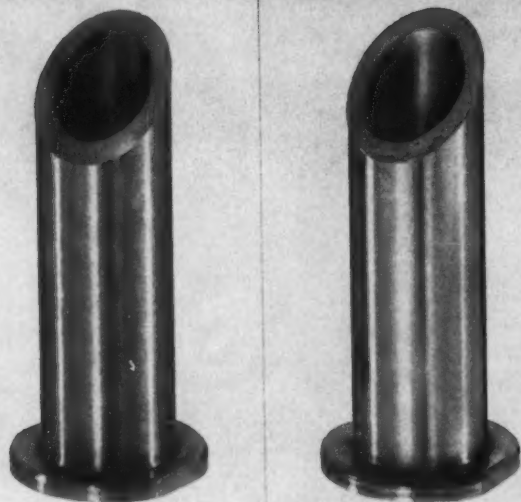


Fig. 2. Typical screw-machine part (left) having a surface roughness of 35 micro-inches is compared with an identical work-piece (right) that has been barrel-finished to improve surface, round edges, and blend tool marks.

sive machining operations to produce fine finishes and to those who have high hand-polishing costs. The cost saving realized is derived from bulk loading and processing of parts, and a reduction of direct labor costs. Barrel finishing, however, must be intelligently combined with other operations to take the full advantage of the economy it offers. A few examples will illustrate this point.

In Fig. 1 a bronze sand-cast plier part is shown both before and after a long barrel-finishing operation. The problem here was to improve the surface of the casting and produce a smooth bright surface while blending in the marks left from a prior abrasive-belt grinding operation to remove the gate and flash. In addition, there were certain dimensional limits for the radius on the nose end of the plier.

To produce a smooth surface on this part, the metal had to be removed to the level of the deepest belt mark. A coarse-grit belt (approximately 40 grit) was employed to grind off the flash. The

belt marks produced were deeper than the irregularities in the sand casting, and therefore, the part had to be processed longer than necessary to give the cast surface the proper smoothness. In the example, the grinding has been carried to the point where the allowable limits on the nose radius have been approached, if not exceeded. Even with long processing, deep belt marks are still very much in evidence.

If a finer-grit belt had been used, the barrel-finishing operation could have produced the desired surface improvement in a much shorter, more economical operation, and without producing an excessive radius. The cost of the long (forty-hour) cycle was relatively high (about 5 cents per piece), but 80 per cent of this cost was due to the necessity of blending in the belt marks. If a finer belt had been used, a smooth bright surface could have been produced on each piece for less than 1 cent.

For many years, screw-machine parts have been processed in bulk economically in barrel-finishing machines. A typical part, shown at the left in Fig. 2, was machined to a surface roughness of 35 micro-inches and then barrel-finished, as seen at the right. This was done to improve the finish still further while blending in tool marks and generating radii. The barrel-finishing operation cost 0.2 cents per piece. Additional machining operations to produce the same results would have cost approximately four times as much.

The refrigeration compressor rotor shown in Fig. 3 was processed by another method which produces low micro-inch surface finishes and holds close tolerances. While not, strictly speaking, barrel finishing, this process was developed through experience gained in working with special barrel-finishing machines. In this case, 0.003-inch radii had to be formed on the slots in the rotor head—without changing the rotor dimensions or roughening the finish on the bearing surfaces or the rotor. The part was processed in an eight-spindle Roto-Matic machine at savings of more than \$200 a day.

During the operation, rotor heads exhibited a maximum dimensional change in width of 0.00005 inch, and a reduction in surface rough-

Table 1. Comparative Costs of Improving Surface Finishes by Multiple Machining Operations

	Reduction in Surface Roughness, Micro-Inches	Comparative Cost
Operation 1	500 to 200	X
Operation 2	200 to 80	2X
Operation 3	80 to 8	4X
Total Cost	500 to 8	7X

Table 2. Surface Finishes Suitable for Working to Various Tolerances

Dimensional Tolerances, Inch	Surface Roughness, Micro-Inches
Below 0.0002	Below 8
0.0002 to 0.0005	8 to 16
0.0005 to 0.0020	16 to 32
0.0020 to 0.0050	32 to 64
0.0050 to 0.0100	64 to 250

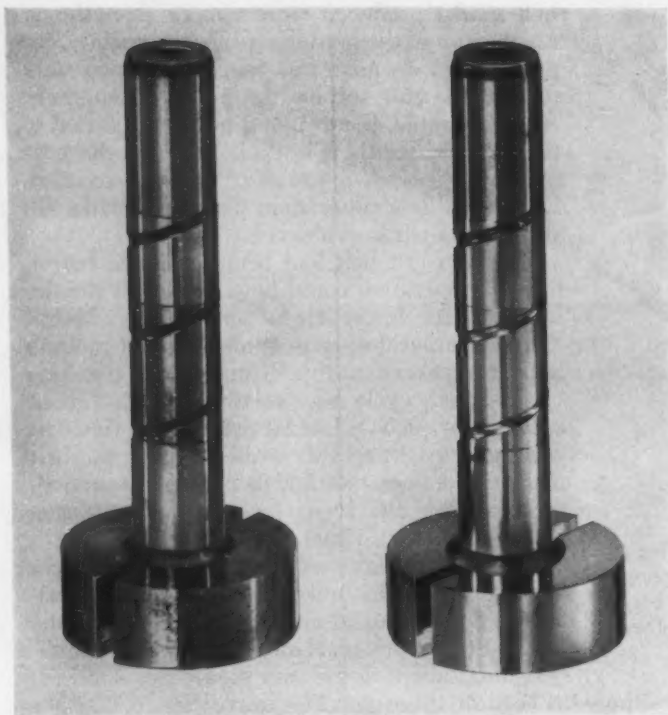


Fig. 3. Refrigeration compressor rotor before and after processing by a special barrel-finishing technique. The edges of slots in the rotor (right) were rounded, the surface finish was improved, and the oil groove was deburred.

ness of from 17 to 8 micro-inches on the periphery. In addition, the rotor bearing surfaces were also improved and the oil groove deburred. Maximum eccentricity of the rotor heads was 0.00002 inch.

The roller shown in Fig. 4 is from a spherical bearing which had a ground surface finish of 10 to 12 micro-inches that was reduced to 2 to 3 micro-inches by a newly developed precision barrel-finishing process. The cost was less than 9 cents per pound, which means a per piece cost of from 0.5 to 6 cents, depending on the size of the roller. A lapping operation to produce the same surface would cost approximately five times more. Where lapped finish tolerances are not

required, a barrel-finishing operation can produce surfaces equivalent to lapped finishes at lower costs. The shape and tolerances developed during the last machine grinding operations are maintained, since no more than 0.00005 inch is removed. Bearings with this finish perform better than those which have only been ground.

Finishes in a range from 6 to 10 micro-inches can be produced easily and economically in a barrel-finishing process. Stainless-steel jet blades have been processed to blend the leading and trailing edges and simultaneously produce a fine (6-micro-inch) matte surface having very little reflectivity. These cases illustrate the wide application of precision barrel finishing.

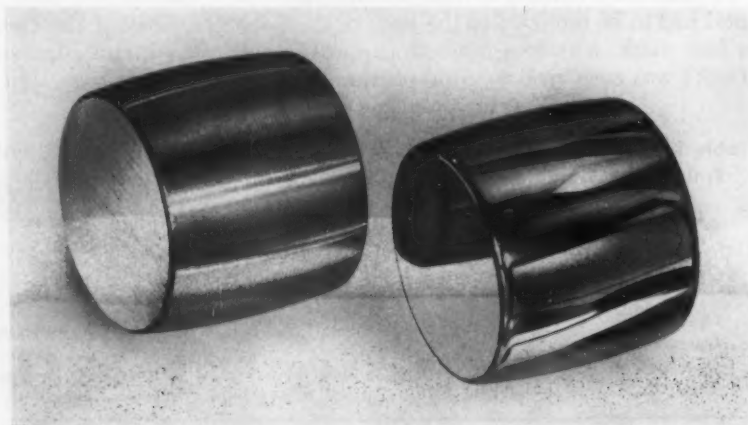


Fig. 4. The spherical-bearing roller seen at the right has been barrel-finished, reducing the surface roughness from 10 to 12 micro-inches to 2 to 3 micro-inches. Part at left is as it appears before the operation.



Band Saws Provide New Manufacturing Approach

Difficult-to-hold jet-engine parts now are easily and economically "segmented" from forged ring blanks

A TEAM of two band-sawing machines plays a key role in processing turbine exhaust strut covers at Pratt & Whitney Aircraft's Southington, Conn., plant. Four different covers are produced. They are made of heat-resistant steel—AMS 5645 and 5735—and consist of complex angles and radii. All have one or more mounting lugs. Front and rear views of one of the covers appear in Fig. 1.

Several manufacturing methods were considered initially. Cutting the covers out of a solid billet was prohibitively wasteful of machine time, labor, and valuable material. Investment casting, while eliminating those objections, was not sufficiently accurate. Forged blanks appeared to be the answer, even though they required several difficult milling operations which also presented holding problems.

Realizing that all four exhaust strut cover styles could be considered geometrically as segments of true figures of revolution, it was decided

to slice the blanks from forged rings. Integral flanges in the forgings provide the material for the lugs. The advantages of this method: The forging dies for a ring are simpler than the dies required for individual blanks. While the work is still in the form of a ring, much of the roughing and finishing can be done by turning—generally a less expensive machining method than milling. Furthermore, the segmenting and the notching (the removal of the excess stock on the lugs) can then be done inexpensively and rapidly by band sawing.

After forging, the inner and outer contours of the ring are machined on vertical turret lathes. Segmenting and notching operations follow, as can be seen in the heading illustration. A close-up view of the segmenting appears in Fig. 2. Both band saws are DoALL Contour-matic machines, equipped with Demon high-speed steel blades.

Although one of the main advantages of band sawing is the simplicity of the fixturing, it was

decided to design a fixture that would be as rugged and as foolproof as possible. For that reason, the fixture completely constrains the rings in the area adjacent to the saw cut, and locates them positively, independently of the operator's judgment.

The three major parts of the segmenting fixture consist of two blocks and a baseplate. One of the blocks fits the external contour of the ring; the other, the internal contour. The baseplate is mounted on a wedge-shaped riser so as to pro-

duce the desired angle of cut. An arbitrary reference plane through the cover appears on all operation sheets. Tooling balls in the fixture orient it to this plane. The block fitting the internal contour is mounted on a slide so that the ring can be locked in a viselike action between it and the block fitting the external contour (which is fixed).

Since the flanges around the periphery are wide and thin, they have to be constrained rigidly during the cut. If the fit between the external-contour block and the ring were made close enough to hold the thin flanges, there would then be the possibility of sticking or jamming. For this reason, the slots for the flanges have ample clearance, and a set of equalizing clamps holds each flange rigidly during the cut. The handwheels used to tighten the clamps can be seen on the fixture in Fig. 2.

On the baseplate is a work-stop that governs the width of the segments cut from the ring. The stop is designed as a slide, to permit its withdrawal for the initial cut and also to permit each segment to be extracted from the fixture following sawing. To load the fixture, the internal-contour block is swung out of the way. The fixture is bolted to the table, which is power-fed.

Following the segmenting, the large hole required in the strut cover is drilled. A smaller hole is also drilled (and later cut away) for locating the cover during subsequent processing. The reference plane passes through the centers of these two holes.

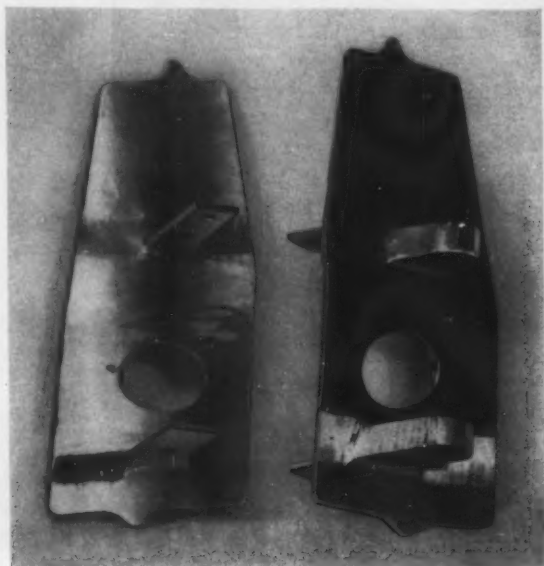


Fig. 1. Front (left) and rear views of one of the four styles of turbine exhaust strut covers now band-sawed from a large forged ring.

Fig. 2. The first band-saw operation consists of cutting the ring into segments. On the table can be seen the segment removed by the initial two cuts.





Fig. 3. In the second band-saw operation, the excess flange material around the lugs is removed. Fixture is free on the table, and has four sawing positions.

The other band saw is now used to notch out the excess material from the flanges. Later the flanges are milled to close tolerances, forming the lugs seen on the cover in Fig. 1. A view of the notching operation is shown in Fig. 3. One of the notched covers appears in the foreground on the table.

Separate fixtures are used to notch the two sides of the cover. Each consists essentially of a yoke and block between which the cover is held. (A cap-screw threaded in the yoke passes through a clearance hole in the block.) The block is fastened to side plates that rest on the table of the band saw. These plates are dimensioned to give the fixture four sawing positions, each position locating one cut.

Since the fixture is free on the table, carbide guides have been incorporated in it to prevent cutting the work except where desired. A backup bar is bolted to the table, so that the power feed can be utilized to advance the work during the notching.

Once the lugs have been subsequently milled, the outside contour of the strut cover is blanked out on a 50-ton press. All surfaces then are hand-blended together.

Refractory Materials Applied by Plasma Flame

Application of high-temperature materials by the plasma-flame-spray technique is no longer a laboratory curiosity. That this technique has graduated to a versatile industrial tool was demonstrated recently when the Metallizing Engineering Co., Inc., of Westbury, N. Y., put one of its commercial plasma-flame-spray guns through its paces. Although temperatures ranging from 10,000 to 15,000 degrees F. are adequate for normal spraying of such high-temperature materials as aluminum oxide, tungsten, and tungsten carbides, steady temperatures up to 30,000 degrees F. can be maintained. Despite the extremely high temperatures involved, the sprayed work remains comparatively cool.

Plasma may be defined as a gas that has been heated until electrically dissociated. It joins solids, liquids, and gases to be known as a fourth state of matter obeying none of the existing gas laws. It is not simply a hot gas, but one to which an entirely new set of rules apply.

Within the gun are two nonconsumable, water-cooled electrodes: the inner electrode is pencil shaped; the outer electrode is the circular, inner end of the nozzle. Almost any inexpensive polyatomic gas—preferably nitrogen to which has been added from 5 to 10 per cent hydrogen—is heated by the formed, direct-current electric arc in a confined space and under pressure. The gas is thus ionized to form the plasma within the nozzle. Spray powder, suspended in a carrier gas (same as plasma gas), is fed into the nozzle from an external tube and enters the plasma flame beyond the arc.

It should be emphasized that the plasma flame is *not* the arc. The arc is confined within the nozzle and does not leave the gun. Long nozzle life can be expected as the arc never actually touches the outer electrode. This is accomplished by the flow of nitrogen through the gun. The high-velocity plasma gas surrounds the arc, pinching it within the nozzle.

MATERIALS

The properties and new applications of materials used in the mechanical industries

Titanium-Carbide Tool Bits for Machining

Titanium-carbide tool bits, with a dense and very fine-grained structure that is composed of a uniform dispersion of titanium carbide in a metal binder of nickel and molybdenum, have been developed by the Ford Motor Co., Dearborn, Mich. The steel-cutting grades, used for semifinish and finish machining, have a hardness range of 90 to 93 Rockwell A. The material has the following nominal composition: titanium carbide, 80 per cent; nickel, 10 per cent; and molybdenum, 10 per cent.

Nonwoven Scratch-Free Fabric for Dusting Precision Instruments

A nonwoven, scratch-free fabric designed to pick up and hold dust has been introduced to industry by Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. Called "Scotch Brand Dusting Fabric No. 550," this thin rayon type material can be used to collect dust several times without losing its effectiveness. It is made of extra-long rayon fibers, bound together with a synthetic, odorless, unifying resin which in use does not leave any sticky or oily deposits on the dusted surfaces. The fabric is available in 12-inch-wide by 30-yard-long rolls, each of which provides sixty individual dusters.

Resin-Bonded Quartz Sheet with High Heat Resistance

A material with high heat-resistant properties has been developed by Cordo Molding Products, Inc., 230 Park Ave., New York, N. Y. Called "Resin Bonded Quartz Sheet," it is a combination of reinforced plastics and ceramics. More specifically, it is composed of finely divided particles of fused quartz bonded together with Cordo Pyropreg resin and includes a small percentage of glass or other fibers which are included to give the sheet good handling properties. Recommended

for use as a facing on a laminate of standard Pyropreg reinforced plastic, it should find use as an ablation-resistant material in the rocket and missile field.

Abrasion-Resistant Plastic-Coated Strip Steel in Coils

The availability of highly decorative, abrasion-resistant, plastic-coated strip-steel coils has been announced by Enamelstrip Corporation, subsidiary of National Steel Corporation, Grant Building, Pittsburgh 19, Pa. Called "Miracoil," it makes available to end-product manufacturers a continuous coil, predecorated steel which may easily be fed into end-product manufacturing equipment.

The material may be subjected to the same end-product forming operations as uncoated steel. It may be obtained predecorated in any pattern that can be photographed, such as wood grains, leather, marble, and any color special-effect patterns. The strip material is unaffected by most acids, chemicals, oxygen, and industrial fumes and is highly resistant to abrasion. The coils are available in widths up to 32 inches but will soon be available in 48-inch widths. Uses include the manufacturing of home appliances, furniture, electronic equipment, and many other items.

Organic-Acid-Based Soldering Flux for Industrial Use

A line of fluxes known as "Blackstone Soldering and Tinning Fluxes" is currently being marketed by Blackstone Corporation, Jamestown, N. Y. The fluxes have been in use in the Blackstone plant for more than four years. Due to its own experience in the use of this product, the company is able to offer its customers advice and assistance from a viewpoint not generally shared by other flux manufacturers.

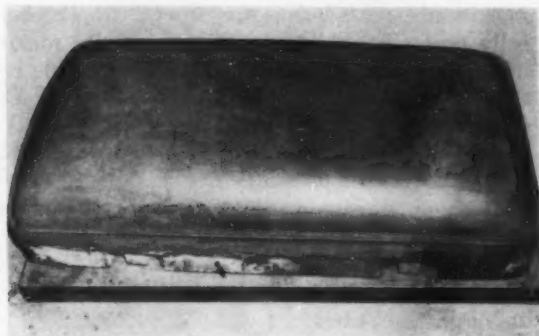
Advantages offered by these fluxes are: non-corrosive residue after soldering; noncorrosive fumes with the resultant elimination of acid-fume damage to stock and equipment—a very signifi-

cant problem in many plants; and a highly detergent cleaning action, as well as safety in preparation and use.

Coiled Tube Rods Available for Open-Arc Hard Facing

Copper-coated tube rods have been made available for semi-automatic open-arc hard facing by Haynes Stellite Co., division of Union Carbide Corporation, 420 Lexington Ave., New York 17, N. Y. "Haynes" 90, 94, 4560, and Nickel-Manganese, "Hascrome," and "Haystellite" tube rods are supplied in the 7/64-inch-diameter drawn size in convenient coils.

The tube rod contains an internal flux to make open-arc deposition possible and insure a sound, slag-free deposit. The copper coating helps prevent rusting, makes feeding easier, and provides better electrical contact through the welding head. As much as 15 pounds of 7/64-inch-diameter alloy rod can be deposited in an hour.



This epoxy-faced punch is used by Allied Products Corporation, Eaton Rapids, Mich., to stamp ambulance roofs. These roofs are 68 inches wide, 158 inches long, and 8 inches deep. The punch is constructed of a zinc-alloy core faced with 3/8-inch thickness (plus or minus 1/8 inch) of an epoxy resin compounded by Ren Plastics, Inc., Lansing, Mich.

One-Part Neoprene-Rubber-Based Coating for Protecting Surfaces

A general-purpose, one-part neoprene-rubber-based coating that provides chemical, abrasion, and weathering resistance for the protection of metal, wood, concrete, cloth, and some plastics has been made available by the Adhesives, Coatings, and Sealers Division, Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.

"Coro-Gard 1706 Brand Protective Coating," as it is called, exhibits high adhesion to unprimed steel, aluminum, copper, galvanized steel, concrete, wood, and glass-fiber-reinforced polyester plastics. The coating air-cures to a tough, rubbery, protective film that has good resistance to the corrosive action of chemicals and fluids at

continuous service temperatures up to 120 degrees F. Its use protects against abrasion and erosion caused by the flow of liquids containing silt and sand.

The material has been used for protecting walls, steel work, tanks, and machinery against industrial atmospheres, acids, caustic vapors, steam, and moisture, and for protecting materials-handling equipment against abrasion.

Aluminum-Silicon Bronze for the Making of Valve Parts

An aluminum-silicon bronze called "Duronze 708," which possesses high strength, corrosion and wear resistance, good machinability, and good fatigue resistance, has been announced by Bridgeport Brass Co., Bridgeport, Conn. Its composition is copper, 91.5 per cent; silicon, 1.75 per cent; and aluminum, 6.75 per cent.

In the annealed temper, it has a tensile strength of 85,000 psi, a yield strength of 40,000 psi, and an elongation of 30 per cent in 2 inches. It retains its physical properties up to temperatures of about 600 degrees F. and resists oxidation and scaling better than most other copper-base alloys. It is suitable for installations involving low temperatures such as handling liquid air, oxygen, hydrogen, nitrogen, and other cryogenic applications.

Grinding Wheel Coolant that Retards Loading

A treatment for grinding wheels that retards loading and functions as a dry coolant has been announced by King Graphite Products, Inc., 21950 Telegraph Road, Trenton, Mich. "Dri-Kool," as it is called, impregnates the pore surfaces and prevents the chipped metal from gripping the abrasive and bond surfaces with the usual affinity. Burr-free, burn-free dry grinding of high-speed steels may be accomplished with infrequent dressings. A single treatment is sufficient for the life of the wheel.

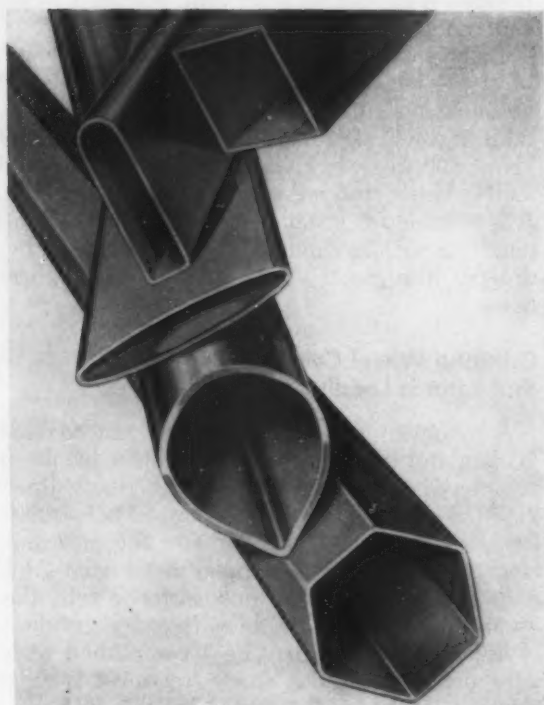
Stripping Agent for Magnesium and Other Metals

A stripping fluid that quickly attacks and removes difficult finishes without harmful corrosive effects to the metal product has been announced by Beck Equipment Co., 3350 W. 137th St., Cleveland 11, Ohio. Called "Epoxystrip No. NC-194 (noncorrosive)," this compound will not corrode magnesium, steel, aluminum, brass, or any combinations of these metals. It will remove tough modern finishes such as epoxies, polyurethanes, and new acrylics, as well as the conventional paints, lacquers, and enamels.

The treated finish swells, pops loose, and is flushed away with water. The metal surface is left clean with no removal of, or damage to, the bonderizing or phosphate coating. When dry, the part is ready for refinishing. The stripping agent is used for preparing rejected parts for refinishing and also for removing paint from work-holders.

Tubing Available in a Wide Range of Sizes and Shapes

Square, rectangular, and special-shaped carbon; low-alloy, high-strength; and stainless-steel tubing for pressure, mechanical, heat-resisting, ornamental, and atomic applications has been made available by the Standard Tube Co., 24400



Carbon, low-alloy, and stainless-steel tubing can be obtained from the Standard Tube Co. in shapes such as these.

Plymouth Road, Detroit 39, Mich. A great variety of special cross-sectional shapes is available in a broad range of sizes. The tubing has been formed from round-tube stock. It has approximately the same peripheral dimensions as the original round tubing from which it is formed.

Round-tube dimensions range from 5/8 to 6 inches O.D. with wall thicknesses from 0.028 to 0.250 inch for the carbon and low-alloy steel, and from 5/8 to 4 3/4 inches O.D., with wall thicknesses from 0.028 to 0.165 inch for the stain-

less steel. Typical shapes which may be obtained are illustrated in the accompanying figure.

Hydraulic Power-Unit Conditioner that Cleans, Conditions, and Lubricates

A product specially formulated for use in hydraulic power equipment to stop sticking in hydraulic valve systems due to varnish-like deposits and friction is being manufactured by Gard Products Co., Kansas City, Kan. Called "Hydra-Gard," this additive reduces harmful frictional wear and corrosion to allow smoother and cooler operation of hydraulic power units to assure positive valve action. It is recommended for use in road machinery, high lifts, farm tractors, printing machinery, and other hydraulic power equipment.

Tungsten Coatings that Protect Graphite Rocket Nozzles

Tungsten coatings called "Plasmarc," applied directly to the base metal or on top of undercoatings by using a "Plasma Arc Torch," are successfully protecting solid propellant graphite rocket nozzles, according to an announcement made by the Linde Company, division of Union Carbide Corporation, 30 E. 42nd St., New York 17, N. Y.

The coatings provide protection from high temperatures and pressures in exhaust gases and hold throat erosion to an acceptable minimum even when high-aluminized propellants are used.

Pipe-Joint and Thread-Sealing Compound in Miniature Tubes

An industrial pipe-joint and thread-sealing compound has been made available in miniature tubes by the Crane Packing Co., Dept. MY-3, 6400 Oakton St., Morton Grove, Ill. Each of these tubes contains 1 ounce of "Plastic Lead Seal," as this compound is called.

The compound prevents seizing and galling and lasts for the life of the connection—yet allows easy disassembly because it remains permanently plastic. It is used in a temperature range up to 500 degrees F. and will withstand pressures up to 6000 psi.

Multiple-Purpose Lubricant in Tubes for Grease-Gun Use

A multiple-purpose lubricant offered in tubes has been introduced by Pennzoil, South Penn Oil Co., Oil City, Pa. The lubricant, called "Pennzoil Special Multi-Purpose Lubricant," is a high-melting-point, lithium-base grease which provides rustproof security and good adhesion to metal under all weather and operating conditions.

Machine Tool Builders Discuss *Manufacturing Abroad*



THE ADVANTAGES and disadvantages of manufacturing abroad, by establishing either wholly owned plants or partly owned subsidiaries, received wide attention at the Fifty-Eighth Annual Meeting of the National Machine Tool Builders' Association, held at White Sulphur Springs, W. Va., November 19 to 21.

In his President's Report, Ralph J. Kraut, president and general manager of the Giddings & Lewis Machine Tool Co., claimed that as a result of increased competition from low labor-cost imports and a shrinking export market, the American machine tool industry has begun to move abroad. A recent Association survey showed that 31 per cent of the member companies responding had arrangements to produce machine tools outside the United States. Another 16 per cent reported they did not have such arrangements now, but were planning to make them in the future.

Stating the situation numerically, the Association has been informed that about fifty American machine tool builders presently have foreign manufacturing arrangements; and that these same builders represent in the United States more than 75 per cent of the domestic capacity. From the standpoint of national defense, the implications of this trend are alarming, Mr. Kraut contended. If substantial segments of our aircraft or missile capacity were to begin to move abroad, he said, the threat to the national security would be plain for all to see, and firm steps would undoubtedly be taken to call a halt. But machine tools are less dramatic and less spectacular.

The President's Report, in the main, expressed optimism. New orders of metal-cutting type machine tools for the twelve-month period ending November 30, 1959, came to \$465,000,000. This was a good recovery from the \$281,000,000 total for the calendar year 1958. Compared to the \$519,750,000 total of net orders for 1957 and the

(Top to bottom) Alan C. Mattison, newly elected president of the National Machine Tool Builders Association; Everett M. Hicks, first vice-president; and Francis J. Trecker, second vice-president and director.

\$924,000,000 total for 1956, the industry is today operating at 50 per cent of "normal."

Supplementing Mr. Kraut's remarks was an address, "The Advantages and Disadvantages in Making Manufacturing Arrangements Abroad," and a panel discussion, "How to Manufacture Abroad." The address was given by J. Delano Hitch, Jr., president of Dorr-Oliver, Inc. Panelists included T. Laurence Strimple, president of the National Acme Co.; L. W. Scott Alter, president of the American Tool Works Co.; Bruce F. Olson, president of the Sundstrand Corporation; and James K. Fulks, executive vice-president of the Ex-Cell-O Corporation. Walter K. Bailey, president, Warner & Swasey Co., was moderator.

"Are Labor Bosses Bigger than Uncle Sam?" was the title of a provocative paper presented by William L. McGrath, board chairman of the Wil-

make a survey, etc., he simply hands him his plate. The exhibitor has a recording machine in his booth into which he inserts the visitor's plate, and which provides a printed record for future follow-up. Neither the exhibitor nor the visitor has to write anything out in longhand.

Mr. McIver reported that 129 N.M.T.B.A. members have now signed up for exhibit space. In addition, twenty-nine nonmember companies (publications, oil companies, and others) are going to exhibit. Donovan Hall, a new addition to the Chicago International Amphitheatre, has made possible a 15 per cent increase in exhibit space. Furthermore, all member company exhibits will be located on the ground floor.

George A. Hawkins, chairman of the Advertising and Market Research Committee, and director of market research and sales promotion of the



(Left to right) Graham E. Marx, treasurer of the Association; Grayson M. Stickell, secretary; and John F. Herkenhoff and Hayward A. Gay, new directors

liamson Co. In criticizing the Labor-Management Reporting and Disclosure Act of 1959, he claimed that in the main the broad immunities and privileges of organized labor remain unchanged. Unions, he said, should be made subject to the antitrust laws, just as corporations are; they should have to abide by the same rules as do corporations in regard to political campaign contributions; and unions and their members, like any other citizens, should be subject to the enforcement of existing state and local legislation concerning lawlessness and violence.

"Inquiry Timesaver" plastic plates will speed requests for manufacturers' catalogues and other literature at the 1960 Machine Tool Exposition, claims Donald H. McIver, the Association's Exposition Committee chairman and vice-president, industrial sales, Ex-Cell-O Corporation. Each visitor who so desires will obtain a plastic plate bearing his name, title, company, and address.

When a visitor to any booth wants the exhibitor to send him literature, have a salesman call,

Brown & Sharpe Mfg. Co., presented the awards for the Association's 1959 Advertising Competition. Judging was held in Detroit last September. There were 224 entries, submitted by fifty-two member companies.

Officers elected for the 1959-1960 Association year are: president, Alan C. Mattison (president of the Mattison Machine Works); first vice-president, Everett M. Hicks (vice-president and general manager of Norton Co.); second vice-president, Francis J. Trecker (president of the Kearney & Trecker Corporation); treasurer, Graham E. Marx (vice-president and general manager of the G. A. Gray Co.); and secretary, Grayson M. Stickell (president and general manager of the Landis Machine Co.).

New directors elected were Mr. Trecker; John F. Herkenhoff (president of the Minster Machine Co.); and Hayward A. Gay (vice-president of the Cincinnati Milling Machine Co.). Ludlow King was re-elected executive vice-president of the N.M.T.B.A.

ELECTROSLAG WELDING

an economical method of joining thick sections

ELECTROSLAG WELDING is an arcless process in which an electric current flows from one or more continuously fed, consumable electrodes, as seen in Fig. 1, through a pool of molten slag to the work. The resistance of the slag to the flow of current creates a high heat which melts both the filler electrode metal and the adjacent parent metal, resulting in their coalescence as a weld. Because of the high voltages that can be used and the heat produced, the process is particularly suitable for welding thick sections in a one-pass continuous operation.

An automatic machine, Fig. 2, based on the electroslag welding principle, is being introduced by Arcos Corporation, Philadelphia, Pa. This machine, called the Vertomatic, can be used to join plates and forgings from 1 1/2 to more than 10 inches thick which can be welded in the vertical position. The need for elaborate joint preparation, slag removal, and subsequent grinding is eliminated and significant savings in time and material are provided.

The machine consists essentially of a tripod base, a vertical mast, and a boom, or carriage, which automatically moves upward on the mast

as the weld metal solidifies. Attached to the boom and moving upward with it are: one, two, or three guides for the consumable electrode wire or wires, and two water-cooled copper shoes that bridge the gap between the work-pieces being joined. The shoes form a dam for the deep pool of molten slag and weld metal. Also mounted on the boom are a drive mechanism to oscillate the wire guides between the shoes (thus distributing the heat more uniformly), and a control panel for automatically or manually controlling the welding operations.

Holding clamps that position the copper shoes against the work-pieces are also attached to the vertical moving boom. Each water-cooled shoe is made up of three sections, with the two end sections free to swing about a vertical axis to compensate for any misalignment of the plates to be welded. The center section of each shoe contains two sensing probes—the top probe maintaining a proper slag height by regulating the flow of flux from a hopper mounted on the boom, and the bottom probe controlling the upward movement of the boom by means of a relay circuit and motor drive mechanism.

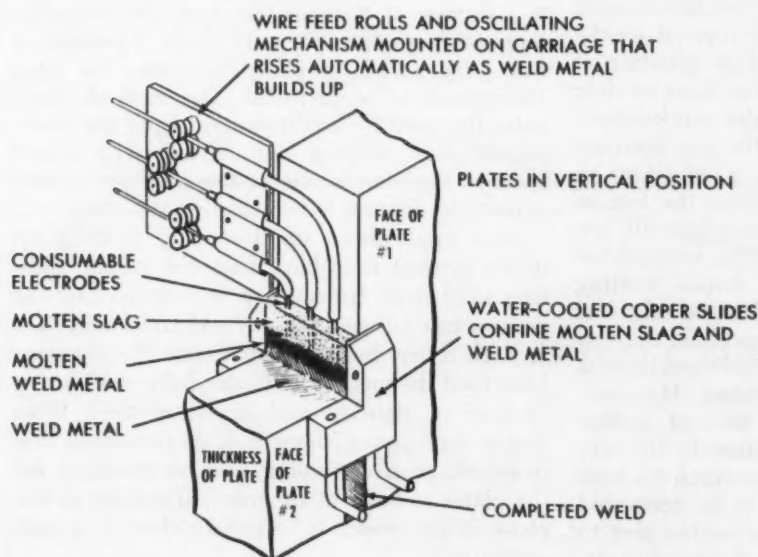


Fig. 1. Diagrammatic representation of essential elements of electroslag welding. Plate 2 has been cut away to show how electric current flows from the consumable electrodes, through a pool of molten slag to the work.

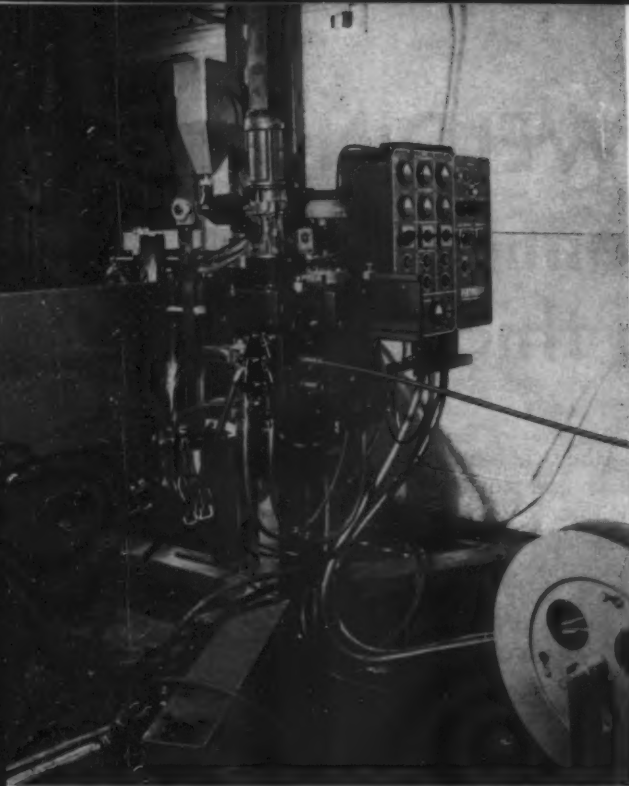


Fig. 2. Vertomatic machine for electroslog welding consists essentially of tripod base, vertical mast, and boom which automatically carries the welding equipment upward.

A transformer is provided for each electrode wire to be used. The speed at which wires are fed from coils held in reels determines the current used. Two kinds of wire may be used: solid wire which requires a deoxidizing flux fed from the hopper as needed, or a flux-cored wire. Welding is currently being done with 1/8-inch-diameter wires, but experiments are being conducted with larger diameters.

Edges of the work-pieces to be joined need only to be cut squarely for any type of weld—butt, T-joint, or inside fillet. A light grinding of the edges is advisable to allow the shoes to slide smoothly along the faces of the work-pieces. Alignment and maintenance of the gap between the two work-pieces (which is a minimum of 1 inch) is achieved by tack welding the legs of one or more large U-shaped members to the faces of the work-pieces opposite the wire guides.

Welding is initiated in a U-shaped starting tab that is tack-welded to the bottom edges of the parts, with the U-opening straddling the gap between the work-pieces. Initial welding is the same as submerged arc welding. However, as soon as a sufficiently deep pool of molten slag is built up there is a transition to the arcless melting electroslog process in which the heat required for coalescence ceases to be generated by an arc. The resistance of the molten slag to the current flow becomes the dominant heat-

creating factor. During this start-up period, the operator makes the necessary control adjustments to change the transformer operation from constant current to constant voltage characteristics. Then the operation is made fully automatic, with only occasional readjustments necessary by the operator. Two "run-off" tabs are tack-welded to the upper edges of the work-pieces—one on each side of the gap—to provide a dam for the conductive slag in finishing off the weld.

Vertomatic equipment has also been used to make circumferential welds in joining sections of a heavy-walled cylinder. In making such welds, the copper shoes are designed to fit the contour of the cylinder, and they remain in a fixed position during welding. The probe circuit (which controls the upward movement in making longitudinal welds) is connected to rolls which rotate the work-pieces.

A rapid deposition rate is obtained in electroslog welding. With a single electrode, the rate is 35 to 45 pounds per hour. In joining very thick plates, where three electrodes can be used, this rate would result in a deposit of 105 to 135 pounds per hour. To fill a nominal joint spacing of 1 inch between plates ranging from 3 to 12 inches thick, welding speeds from 2 to 4 feet per hour are indicated. This, plus the fact that the process is continuous, results in substantial savings in time.

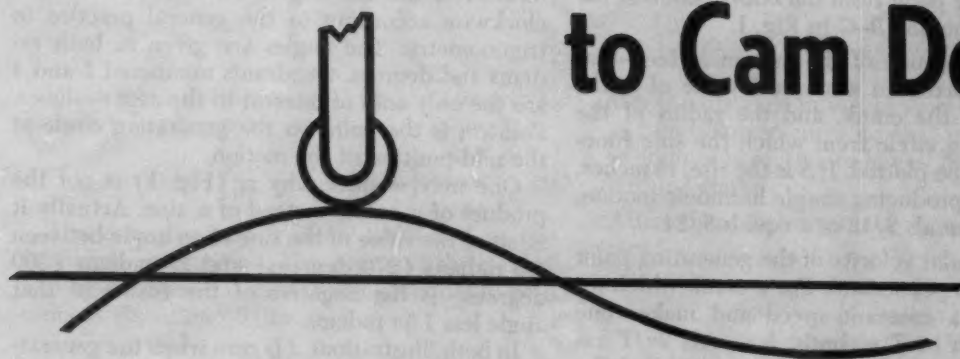
Material savings when welding heavy plates are also significant. Because the process is a one-pass operation, slag removal is not necessary and expensive material does not have to be wasted in making wide gaps. Also, joint preparation costs are at a minimum, and there is a saving due to the use of less filler metal. There is a saving, as well, in flux cost, since electroslog welding consumes only about 5 pounds of flux (depending on plate thickness) for each 100 pounds of weld metal. The method eliminates the need for any repositioning of the work-pieces after welding has started. The tripod base of the Vertomatic is mounted on rollers, permitting the unit to be moved to the work.

Most applications of electroslog welding up to the present time have been for joining ordinary mild steel. However, it is believed that the process can be used for any weldable materials. In fact, it has been reported that the Russians have used the method to successfully weld heavy sections of stainless and low-alloy steel. With proper techniques, there is little distortion due to shrinkage after cooling, and no tendency for the plates to bend at the joint. Shrinkage in the plane of butt welds is limited to about 1/4 inch maximum.

MACHINERY'S

Reference Section

APPLYING SINE CURVES to Cam Design



SHERWOOD C. BLISS, Kenmore, N. Y.

January, 1960

Applying Sine Curves to Cam Design

SHERWOOD C. BLISS, Kenmore, N. Y.

CAMS are often designed to impart simple harmonic motion to their followers. This motion, which characteristically prevents shock loading in many cam applications, is identical to that of a slide actuated by a crank rotating at constant speed and linked to the slide by an infinitely long connecting-rod. The displacement, velocity, and acceleration of simple harmonic motion can all be represented mathematically by sine or cosine functions.

This article discusses the application of sine curves to the design of disc cams having followers that move radially with respect to the center of cam rotation. Although the motion of cam followers is usually along an arc of a circle, the effect of this upon the conclusions derived will be negligible.

The equation for displacement of a point in simple harmonic motion is

$$s = a \sin (bt + e) \quad (1)$$

where

s is the perpendicular distance, in feet, of the generating point from the *mid-position* of the motion, the line $B-C$ in Fig. 1.

a is the amplitude of the motion in feet—that is: the maximum numerical value of s , the radius of the crank, and the radius of the generating circle from which the sine function may be plotted. If S is the rise, in inches, of a cam producing simple harmonic motion, then $2a$ equals $S/12$ or a equals $S/24$.

b is the angular velocity of the generating point in radians per second. For a crank which rotates at a constant speed and makes one revolution in T seconds, b equals $2\pi/T$ radians per second. T is sometimes called the "periodic time." In theory, the cams being considered are equivalent to a crank that rotates $2\pi/2$ radians, or 180 degrees, in T seconds. For these cams, therefore, b equals π/T radians per second.

t is the elapsed time, in seconds, since the start of the motion.

e is the angle, in radians, measured from the *mid-position* to the point where motion starts.

The generating point of the motion may be considered the center of a roller type cam follower. Then, after substituting $S/24$ for a and π/T for b , Equation (1) for the displacement s of the follower becomes

$$s = \frac{S}{24} \sin \left(\frac{\pi t}{T} + e \right) \quad (2)$$

and

$$V = \frac{\pi S}{24 T} \cos \left(\frac{\pi t}{T} + e \right), \quad (3)$$

the differential of Equation (2), gives the velocity V of the cam follower in feet per second. Similarly,

$$a^1 = -\frac{\pi^2 S}{24 T^2} \sin \left(\frac{\pi t}{T} + e \right), \quad (4)$$

the differential of Equation 3, gives a^1 , the acceleration of the follower, in feet per second per second at elapsed time t .

In Figs. 1 and 2, the quadrants of a circle are numbered and the angles dimensioned counter-clockwise according to the general practice in trigonometry. The angles are given in both radians and degrees. Quadrants numbered 1 and 4 are the only ones of interest to the cam designer. Point m is the point on the generating circle at the *mid-position* of the motion.

One may wonder why s_1 (Fig. 1) is not the product of a cosine instead of a sine. Actually it is, since the value of the sine of an angle between 1.5 radians (270 degrees) and 2π radians (360 degrees) is the negative of the cosine of that angle less 1.5 π radians.

In both illustrations, t is zero when the generating point is 1.5 π radians (270 degrees) in advance of the *mid-position* m . Consequently, the value of e in Equations (2), (3), and (4) is 1.5 π radians. Although the substitution of 1.5 π radians for e allows the motion to be considered as starting at the line $E-F$, the ordinates s of the sine curve as calculated using Equation (2) still have to be laid off up or down from the line $B-C$ through the *mid-point* m . In order for the calculated ordinates to be laid off from the line $E-F$, the term $S/24$ would have to be added to Equation (2).

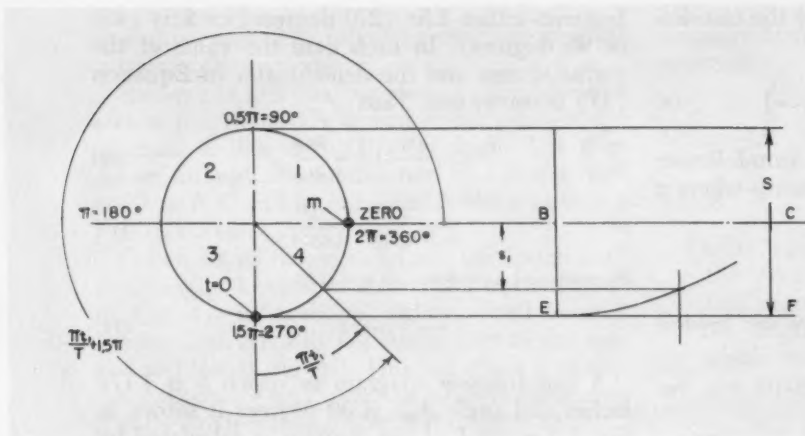
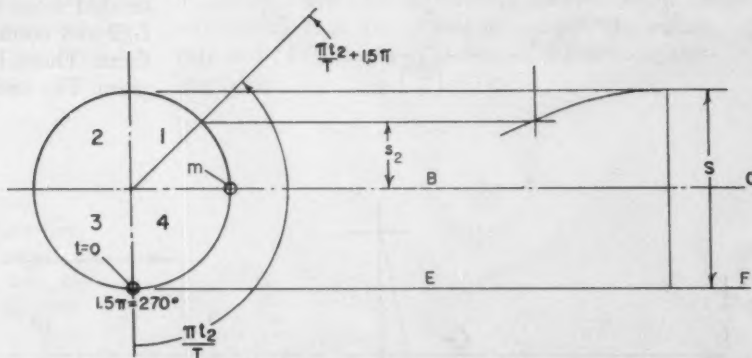


Fig. 1. Here ordinate (s_1) of a sine curve is determined from a point on the generating circle in the fourth quadrant.

Fig. 2. Ordinate (s_2) is obtained from a point in the first quadrant of the generating circle. Only quadrants 1 and 4 concern the cam designer.



With the substitution of 1.5π radians for e , Equation (4) becomes

$$a^1 = -\frac{\pi^2 S}{24 T^2} \sin\left(\frac{\pi t}{T} + 1.5\pi\right) \quad (5)$$

The cam designer is often interested in the maximum acceleration. This occurs at the start of movement when t is zero. Setting t equal to zero reduces Equation (5) to

$$a^1_{\max} = \left(-\frac{\pi^2 S}{24 T^2}\right)(-1) = 0.411 \frac{S}{T^2} \quad (6)$$

This equation shows that the maximum acceleration depends solely upon the values of S and T .

It should be noted that Equations (1) to (6) give the values of s , V , and a^1 in feet. Equation (2) can be changed to give the length of the ordinates (y) of a cam-follower curve in inches by substituting x for t and L for T where

L is the length of the cam-follower diagram (Fig. 3) in inches, and

x is the distance in inches from a point on the cam-follower curve to that end of the diagram where the follower motion (rise of cam) starts.

After these substitutions, Equation (2) becomes

$$y = \frac{S}{2} \sin\left(\frac{\pi x}{L} + 1.5\pi\right) \quad (7)$$

Ordinates (y) of the cam-follower curve given by this equation are measured up or down from what has been termed the mid-position—the line $B-C$ in Fig. 3. This can also be called the “pitch line” of the cam-follower curve.

The sole purpose of transforming Equation (2) is to obtain one which will give the relationship between the length L of the cam-follower diagram and the maximum slope of the cam-follower curve. The differential of Equation (7), dy/dx , is

the tangent of angle A , the slope of the cam-follower curve:

$$\frac{dy}{dx} = \tan A = \frac{\pi S}{2L} \cos \left(\frac{\pi x}{L} + 1.5\pi \right) \quad (8)$$

A_{\max} , the maximum slope of the cam-follower curve, occurs at the middle of the curve—where x equals $L/2$. At this point

$$\left(\frac{\pi x}{L} + 1.5\pi \right) = 2\pi$$

The cosine of 2π radians, or 360 degrees, is one; therefore at $L/2$:

$$\tan A_{\max} = \frac{\pi S}{2L} = 1.5708 \frac{S}{L} \quad (9)$$

or

$$L = 1.5708 S \cot A_{\max} \quad (10)$$

The radius (r) of curvature of a curve can be obtained from the equation

$$\frac{1}{r} = \frac{\frac{d^2y}{dx^2}}{\left\{ 1 + \left(\frac{dy}{dx} \right)^2 \right\}^{3/2}} \quad (11)$$

becomes either 1.5π (270 degrees) or 2.5π (450 or 90 degrees). In each case the value of the cosine is zero and the denominator in Equation (11) becomes one. Thus

$$\frac{d^2y}{dx^2} = \frac{1}{r} = \frac{\pi^2 S}{2L^2} \quad (12)$$

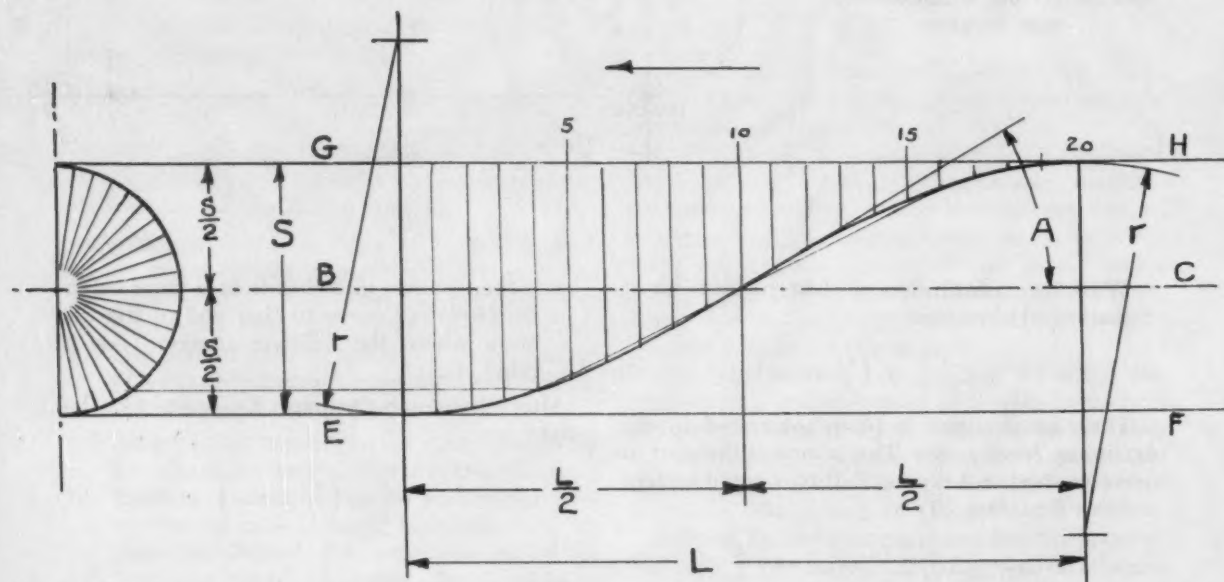
or

$$r = \frac{2L^2}{\pi^2 S} = \frac{L^2}{4.9348 S} \quad (13)$$

By combining Equations (10) and (13):

$$r = \frac{S}{2} (\cot A_{\max})^2 \quad (14)$$

A cam-follower diagram in which S is 1 1/2 inches and angle A_{\max} is 30 degrees is shown in Fig. 3. Length L of the diagram as calculated by Equation (10) is 4.081 inches and radius r at the ends of the curve as calculated by Equation (14) is 2 1/4 inches. Arcs of radius r have been extended from both ends of the diagram towards $L/2$ and connected by a straight line tangent to them. These lines are drawn lightly on the diagram. The ordinates of the sine curve shown by



A harmonic (sine) cam-follower curve has the greatest curvature at the ends—where x equals either zero or L . When these values are substituted in Equation (8), the term

$$\left(\frac{\pi x}{L} + 1.5\pi \right)$$

the heavier line were calculated to show how its end portions agree with radius r as determined from Equation (14).

For many years it has been the practice to lay out a sine curve on a cam-follower diagram from a generating circle as shown in Fig. 3. This is a

slow procedure. The following alternate method is sufficiently accurate:

Radius r is first calculated on a slide rule and arcs of this radius are drawn at each end of the diagram. A line at the desired angle A is then drawn through the intersection of a line at $L/2$ and line $B-C$ and is connected to the arcs with a French curve.

On an actual disc-cam layout, the "pitch line" $B-C$ in Fig. 3 becomes an arc of a circle ($B'-C'$ in Fig. 4). In addition, radius r will become greater than $2\frac{1}{4}$ inches at the start of the cam rise and less at the end. This last effect is of special importance whenever the follower movement S or the angle which subtends the rise is small.

The slope at $\frac{L}{2}$ angle A_{\max} can be termed the "angle of action." It is the only cam element which does not change when the diagram is transferred to the cam layout. Some designers have considered 30 degrees to be the upper limit for angle A_{\max} for harmonic-motion cams.

Fig. 3. Cam-follower diagram of a disc cam having a rise (S) of $1\frac{1}{2}$ inches. The maximum slope (A_{\max}) is 30 degrees and occurs at ($L/2$). Line $B-C$ may be termed the "pitch line" of the diagram.

Before the cam layout (Fig. 4) can be made, the ordinates of the cam-follower curve must be determined. Use of line $G-H$ as a base from which to measure these ordinates is convenient for both the machinist in setting up to mill a cam and the toolmaker in producing a master cam.

It is often advantageous, for instance, to first turn the blank of an experimental cam to the largest finished diameter. The periphery is then available as a convenient reference surface from which to work. Knowledge of the ordinates as measured from the line $G-H$ facilitate this method. If desired, the ordinates may be reversed end for end so that $E-F$ can be used as the base line.

Ordinates (y^1) of the cam-follower curve as

measured from line $G-H$ can be calculated by the equation

$$y^1 = \frac{S}{2} (1 + \sin J) \quad (15)$$

where

J is the "equivalent angle" obtained by dividing the "equivalent 180 degrees of harmonic motion" into the same number of divisions as is the length L of the diagram or the angle B which subtends the rise of the cam on the cam layout.

Since the sine curve is symmetrical it is generally only necessary to calculate half as many equivalent angles as there are divisions. For example, if twenty divisions will give the required accuracy, only ten "equivalent angles" need be calculated. It is convenient to compile the values of J and $(1 + \sin J)$ as shown in the accompanying table.

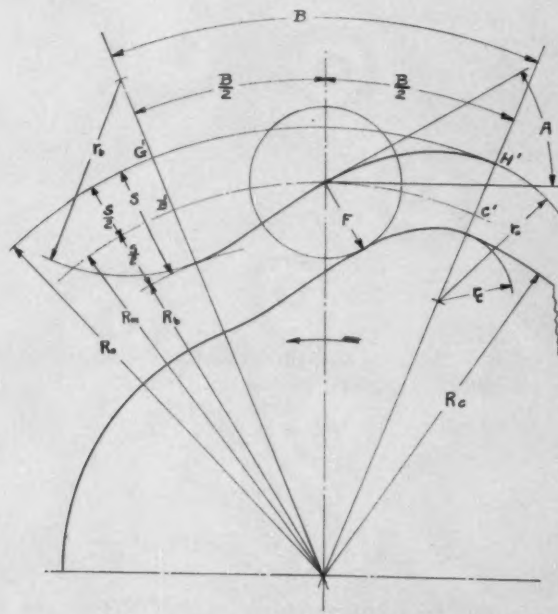


Fig. 4. Cam layout (not full size) based on the diagram shown in Fig. 3. To prevent interference at the high point of the cam, radius (r_a) should be greater than the radius (F) of the roller follower.

The first ten ordinates, beginning at the start of the rise, and measured from base line $G-H$, are calculated directly by Equation (15). Ordinates for the last ten divisions are found by subtracting the ordinates of symmetrical points on the curve from the rise S . The seventeenth ordinate, for example, is equal in length to the rise S minus the third ordinate.

This method was used to plot the cam-follower curve in Fig. 3. Since these calculations will have to be made eventually, the time to make them is when the follower diagram is in the process of being plotted.

The cam layout illustrated in Fig. 4 is based upon the cam-follower curve in Fig. 3, but is not shown full size. Arc $B'-C'$, subtended by angle B , is actually 4.081 inches long and has a radius R_m . This is the "pitch line" of the cam layout. Angle

maximum "angle of action," A_{max} , is 30 degrees—exactly the same as that for the cam diagram (Fig. 3). The radius of curvature r_c at the high end of the cam layout equals r_o minus F , the radius of the roller.

When the diagram is transferred to a cam layout the 2 1/4-inch radius r in Fig. 3 is affected in two ways. First, the ordinates are laid off from arc $G'-H'$ having a radius R_o . The effect of this is to increase the curvature of the cam-follower curve at point H on the cam layout. On the other hand, the spacing of the ordinates along the arc $G'-H'$ is greater than that of the ordinates in Fig. 3. Such increase in spacing flattens out or decreases the curvature of the cam-follower curve, an effect which becomes less and less as the curve approaches the arc $B'-C'$.

The cam designer, however, is interested in the curvature at the high point of the cam. The relation of this curvature to F , the radius of the follower roller, will determine whether or not "cam-contour interference" will be encountered. (Interference occurs when r_o is less than F .) Equation (13) gives the relationship between the radius r of curvature of the cam-follower curve and L and S .

An equation for r_o is derived in the following manner:

$$B \text{ degrees} = \frac{B}{57.296} \text{ radians} \quad (19)$$

Let L_o be the length of the arc $G'-H'$. Then

$$L_o = R_o \frac{B}{57.296} \quad (20)$$

and

$$L_o^2 = \left(R_o \frac{B}{57.296} \right)^2 \quad (21)$$

Let r_1 be the radius of curvature corresponding to r in the cam diagram but as modified by the increased length L_o of arc $G'-H'$. By substituting these values in Equation (13),

$$r_1 = \frac{\left(R_o \frac{B}{57.296} \right)^2}{4.9348S} \quad (22)$$

or

$$r_1 = \frac{(R_o B)^2}{16,200S} \quad (23)$$

By combining Equations (18) and (23),

$$r_1 = \frac{S(90 \cot A_{max} + 0.5B)^2}{16,200} \quad (24)$$

This equation can be used to determine the

Table that Facilitates Calculation of Sine Curve Ordinates

Ordinate Numbers	"Equivalent Angle" J Degrees	1 + sin J
0 and 20	90	2.0000
1 and 19	81	1.9877
2 and 18	72	1.9511
3 and 17	63	1.8910
4 and 16	54	1.8090
5 and 15	45	1.7071
6 and 14	36	1.5878
7 and 13	27	1.4540
8 and 12	18	1.3090
9 and 11	9	1.1564
10	0	1.0000

B is 45 degrees and subtends the rise of the cam. Radius R_m is given by the equation

$$R_m = \frac{180 L}{\pi B} = \frac{57.296 L}{B} \quad (16)$$

and R_o , the radius of arc $G'-H'$, is given by

$$R_o = R_m + \frac{S}{2} = \frac{57.296L}{B} + \frac{S}{2} \quad (17)$$

By combining Equations (10) and (17)

$$R_o = \frac{S}{B} (90 \cot A_{max} + 0.5B) \quad (18)$$

R_o as calculated by Equation (18) is 5.946 inches. Since the radius F of the cam-follower roller is 1 inch, the outside radius R_c of the cam is, therefore, 4.946 inches. On the cam layout, the

change in the radius r (Fig. 3) caused by the difference between the length of L (Fig. 3) and L_o , the length of the arc $G'-H'$ in the cam diagram (Fig. 4).

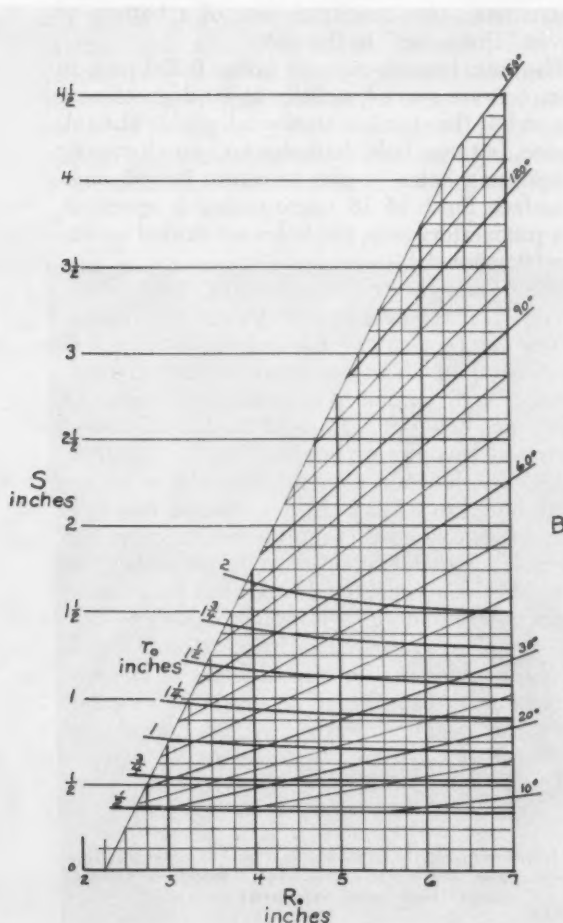
Curvature is defined as the reciprocal of the radius or $1/r$. To find the curvature $1/r_o$ at the high point of the cam-layout curve, the curvature of the arc of radius r_1 must be added to the curvature of the arc $G'-H'$ or $1/R_o$.

$$\frac{1}{r_o} = \frac{1}{r_1} + \frac{1}{R_o} \quad (25)$$

This verifies the fact that the effect of laying out the ordinates from arc $G'-H'$ of radius R_o is to increase the curvature of the cam-follower curve at H .

By substituting the values of R_o and r from

Fig. 5. Chart showing relationships between cam rise (S), angle (B) subtending the rise, radius (R_o) and radius (r_o) of harmonic-motion cams having a 30-degree maximum "angle of action" (A_{max}).



Equations (18) and (24) in Equation (25),

$$\frac{1}{r_o} = \frac{16,200}{S(90 \cot A_{max} + 0.5B)^2} + \frac{B}{S(90 \cot A_{max} + 0.5B)} \quad (26)$$

Therefore

$$r_o = \frac{S(90 \cot A_{max} + 0.5B)^2}{16,200 + B(90 \cot A_{max} + 0.5B)} \quad (27)$$

Radius r_o (Fig. 4) as calculated by Equation (27) is 1.974 inches. In comparison, r in Fig. 3 is 2 1/4 inches. The radius r_o on the cam layout is, therefore, 0.974 inch.

A derivation similar to that for Equation (27) can be used to obtain an equation for r_b :

Let r_2 be the radius corresponding to r in the cam diagram but as modified by the reduced length of arc subtended by angle B at radius R_b . Then, since the arcs of r_2 and R_b (Fig. 4) are opposite in curvature,

$$\frac{1}{r_b} = \frac{1}{r_2} - \frac{1}{R_b} \quad (28)$$

The equation for r_b corresponding to Equation (27) for r_o is

$$r_b = \frac{S(90 \cot A_{max} - 0.5B)^2}{16,200 - B(90 \cot A_{max} - 0.5B)} \quad (29)$$

Radius r_b as calculated from this equation is 2.617 inches.

The curve in Fig. 4 (not shown full size) was carefully laid out to scale from calculated ordinates. Agreement between this curve and the end radii r_o and r_b also calculated is apparent.

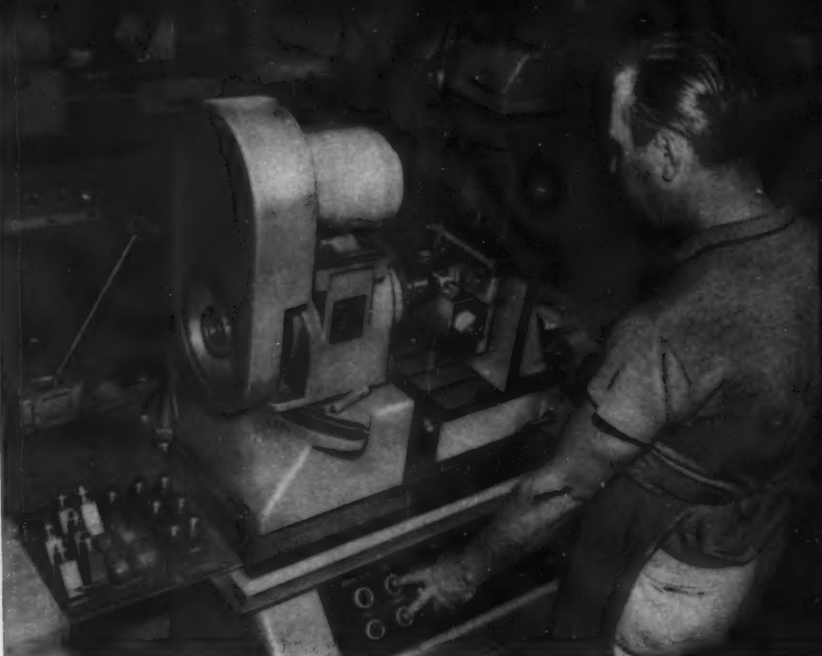
A chart is plotted for a maximum angle of action of 30 degrees in Fig. 5. Any radius R_o less than that determined from the chart will result in a greater angle. Similarly, a larger radius will result in a smaller angle.

The sloping line which originates at the point where R_o equals 2 1/4 inches and S equals zero limits the values of R_o to a minimum of 2 1/4 inches. That is, the smallest radius on the resulting cam will be 2 1/4 inches minus the radius F of the cam-follower roller. Values of r_o shown on the chart indicate the conditions that exist when S and B are small. For cams within this range, R_o can be calculated from an equation derived by combining Equations (18) and (27) and completing a square,

$$R_o = \frac{\sqrt{64,800Sr_o + (Br_o)^2}}{2B} + \frac{r_o}{2} \quad (30)$$

It is a frustrating experience to encounter "cam-contour interference" after spending some time in laying out a cam. This may be avoided by a few minutes' use of a slide rule.

New England Firm Combines Machine Building and Instrument Making



ONE SMALL but important member of New England's bustling electronics and instrument-making community plays a dual role as a builder of machine tools and as a components supplier to the missiles and aircraft industries. The company, located in Norwood, Mass., is the Atlantic Instrument Corporation, a subsidiary of American Electronics Inc. As a tool builder, its product is a line of automatic precision boring, turning, and facing machines. (See *MACHINERY*, September, 1959, page 212, and November, 1959, page 170.)

The other side of the coin shows the company developing and manufacturing gyro spin motors, gimbal assemblies, torsion tubes and rods, gear trains, servo-amplifier blocks and manifold sub-assemblies, variable-geometry controls, and similar "hardware." Typical of the close-tolerance work involved is the boring of bearing-support

holes for a gimbal assembly. The operation appears in Fig. 1. It is performed on one of Atlantic Instrument's own machines—one of a battery of eleven "Unimatics" in the shop.

The four bearing-support holes, 0.250 inch in diameter, are spaced radially at 90 degrees near one end of the stainless-steel work-piece. The tolerance, both on hole diameter and on alignment of opposing holes, is plus or minus 0.0002 inch. A surface finish of 16 micro-inches is specified. In a preparatory step, the holes are drilled under-size (0.242 inch).

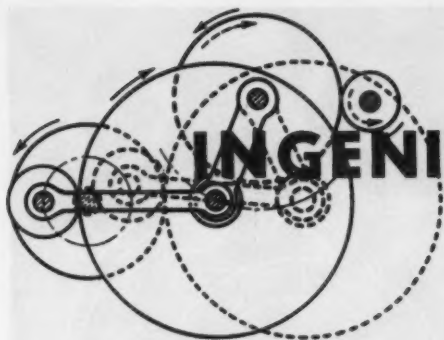
When brought to the Unimatic, each work-piece is cradled in a square ground steel block. (These can be seen to the left of the headstock in the illustration.) The blocks are located on a permanent magnet attached to an angle-plate carried on the machine table. Each of the holes is bored separately by indexing the block on the magnetic chuck. The holes in all work-pieces in a lot are rough-bored to 0.249 inch by a carbide tool held in an adjustable head. Then the head is reset and the holes are finish-bored to 0.250 inch. Still nested in their respective blocks, the work-pieces subsequently undergo a grinding operation.

In the plant's near-sterile "white room," Fig. 2, axial alignment of the gimbal holes is checked with balance beams and a level. Calibrations along the beams indicate the amount of any unbalance.



Fig. 1. (Above) Nested in its block, a gimbal's four bearing-support holes are bored successively. Machine's integral granite base holds key to its accuracy.

Fig. 2. (Left) The 0.0002-inch tolerance on hole alignment is checked by balance beams and a level in the "white room."



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Cam Produces Motion on Alternate Revolutions

L. KASPER, Philadelphia, Pa.

A conventional plate-cam was used on a machine producing a wire product to operate a forming press. The press had to be actuated once during each revolution of the driving shaft. A subsequent product change necessitated an alteration in the operating cycle of the cam—it was now required to operate the press twice during one revolution, then to remain at rest during the next revolution. The accompanying illustrations show

the design and operation of a cam which produced the desired movements with no alterations being required on the machine.

Cam body *A*, Fig. 1, is in the shape of a disc having an integral hub on its front face. The cam is keyed to shaft *B* and rotates in the direction indicated by the arrow. Two studs *C* pass through the disc and are free to rotate. Welded to them are curved bars *D* which act as cam lobes. Com-

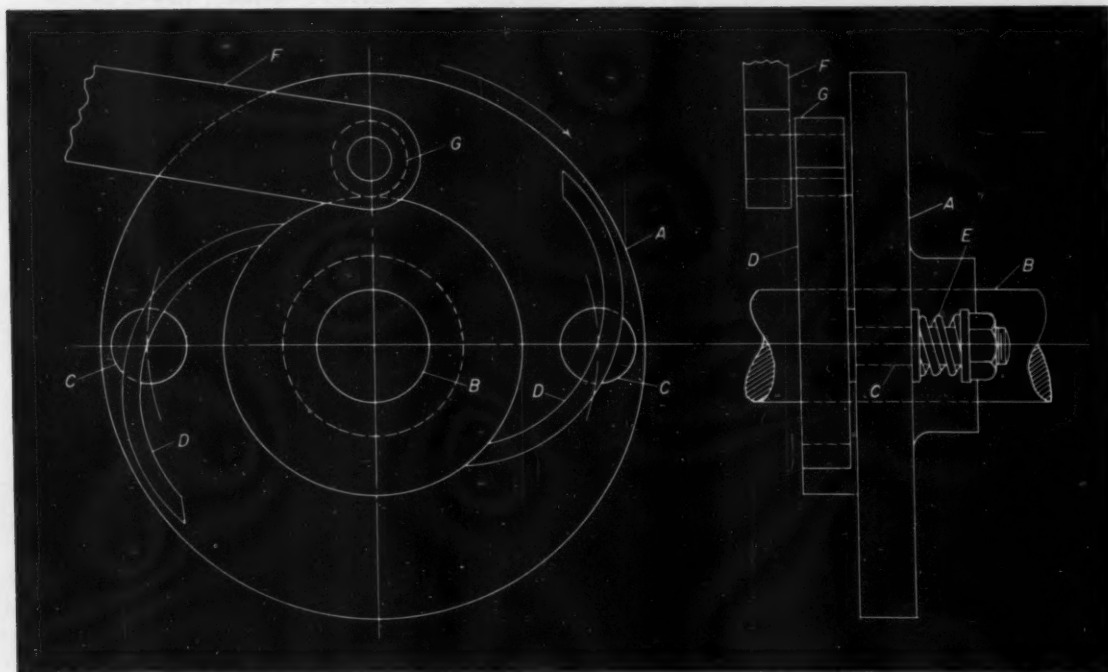


Fig. 1. Cam body (*A*) carries two moving cam-bars (*D*). This design imparts two movements to lever (*F*) during one revolution, followed by one revolution at rest.

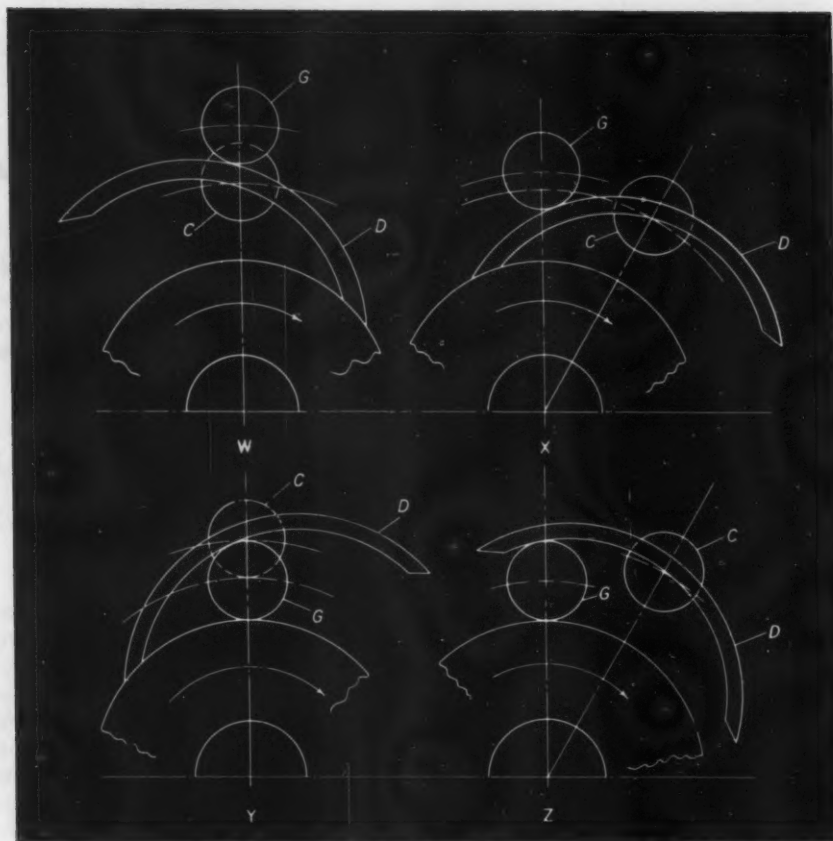


Fig. 2. During the active revolution, follower (G) rises along cam-bar (D), View W, then forces it to pivot for the downward movement, View X. On the next trip around, the upended cam-bar passes over the follower and is returned to its original position, Views Y and Z.

pression springs *E* apply sufficient frictional resistance to the studs to prevent movement by centrifugal force. Lever *F*, which operates the forming press, carries follower-roller *G* and is held against the cam by a spring (not shown).

Operation of the cam is illustrated in Fig. 2. At *W*, cam-bar *D* is in the same position as in Fig. 1, but the entire cam has rotated 90 degrees. Stud *C* and roller *G* are now on the same center line, bar *D* having caused the roller to rise and operate the press through lever *F*. The cam continues to rotate, as at *X*, and spring tension on lever *F* overcomes the frictional resistance of stud *C*, forcing bar *D* into the position shown. When the other lobe of the cam comes into position this action is repeated, so that two movements of the lever are produced, 180 degrees apart, in one revolution of shaft *B*.

No movement of lever *F* is produced during the next revolution of the shaft. This is because the leading ends of the cam-bars have been lifted from the hub of disc *A* and now pass over roller

G, as shown at *Y*. As the cam rotates further, and the roller passes the center line of stud *C*, cam-bar *D* is forced to pivot as at *Z*—thus being returned to its original position (Fig. 1). In this manner, each two-revolution cycle of the cam produces two movements of lever *F*, followed by a rest period of 540 degrees.

There may appear to be an undesirable feature in the design of this cam in that there would be a rapid drop of roller *G* on the falling side of bar *D* (View *X*, Fig. 2). This, however, does not occur. Due to the fact that the outer surface of the cam-bar is on a rising angle (View *W*), downward movement takes place almost immediately after the center of stud *C* passes the center of roller *G*.

Outer surfaces of the cam-bars may be contoured to produce almost any conventional rise and fall pattern. Their inner surfaces must be so dimensioned that there will be sufficient clearance for the passage of roller *G*, and that full closing of the leading ends will be assured when the roller exits from beneath them.

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Induction Gage Measures Shaft Diameter During Grinding

M. M. BARASH and P. L. B. OXLEY, Manchester, England

Continuous measurement of the diameter of a shaft being ground is possible with the gage shown diagrammatically in the accompanying illustration. The device is a Russian development. It has no moving parts or electrical contacts, and works on the principle of a transformer with variable air-gap inductance.

Anvils *A* of the gage rest against shaft *B* being ground. The included angle of the anvils with the work, 2ψ , is 30 to 40 degrees. Inductance pickup *C*, built into the body of the gage, consists of two windings (supply circuit *S* and measuring circuit *M*) and a magnetic core which is open on one side.

As the diameter of the shaft decreases, the distance from its surface to the core of the pickup also decreases. For a decrease in shaft diameter from *D* to *d*, the distance changes correspondingly from *L* to *l*. From the geometry of the diagram,

$$L - l = \frac{d}{2} + \frac{D - d}{2 \sin \psi} - \frac{D}{2}$$

or

$$L - l = \left(\frac{D - d}{2} \right) \left(\frac{1 - \sin \psi}{\sin \psi} \right)$$

thus if $2\psi = 30$ degrees,

$$L - l = 1.44 (D - d)$$

and if $2\psi = 40$ degrees,

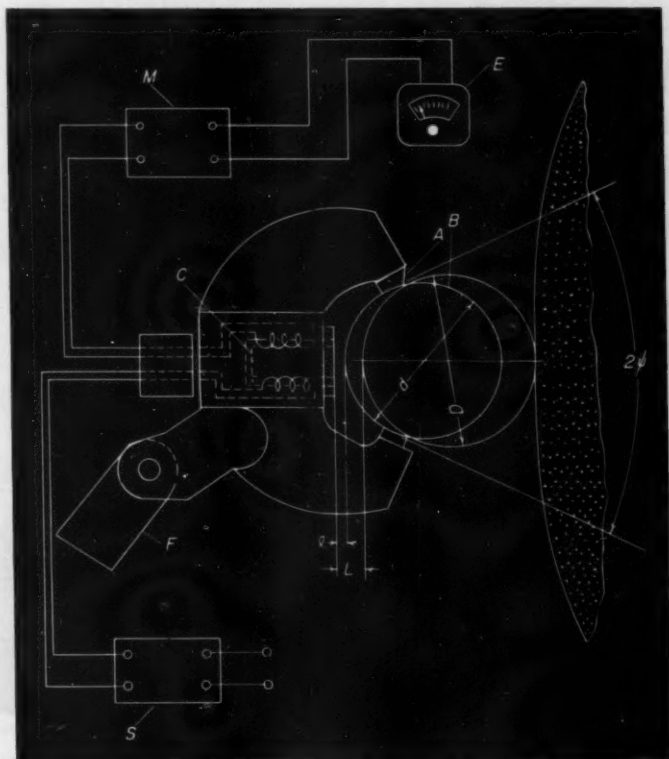
$$L - l = 0.96 (D - d)$$

Voltage induced in the secondary winding (measuring circuit *M*) is a

function of the size of the air gap between the work and the core.

The measuring circuit *M* is connected to a scale-reading instrument *E* having 150 divisions. Each division represents 0.2 micron (0.000007 inch) or more, as required. When grinding has reduced the shaft diameter to proper size, the wheel is retracted either manually or automatically. In the latter instance, a relay is incorporated in the measuring circuit.

The anvils are made of tungsten carbide. Since the pressure on each is only 150 grams, wear is insignificant. Arm *F* is fixed on the grinding ma-



As the shaft is reduced in diameter, the distance between its surface and the core of the pickup decreases, causing a change in the voltage of the measuring circuit.

chine table, and provides a swivel support for the gage.

If several diameters have to be ground, a gage can be provided for each one, the pickups in each being independently adjustable. Setting can be performed with two master work-pieces tempo-

rarily held between the machine centers, one representing the upper limits of the tolerances, and the other, the lower. All pickups are, as a rule, adjusted to give the same reading for the lower-limits master. The air gap should not be more than 0.0006 inch for the lower limits.

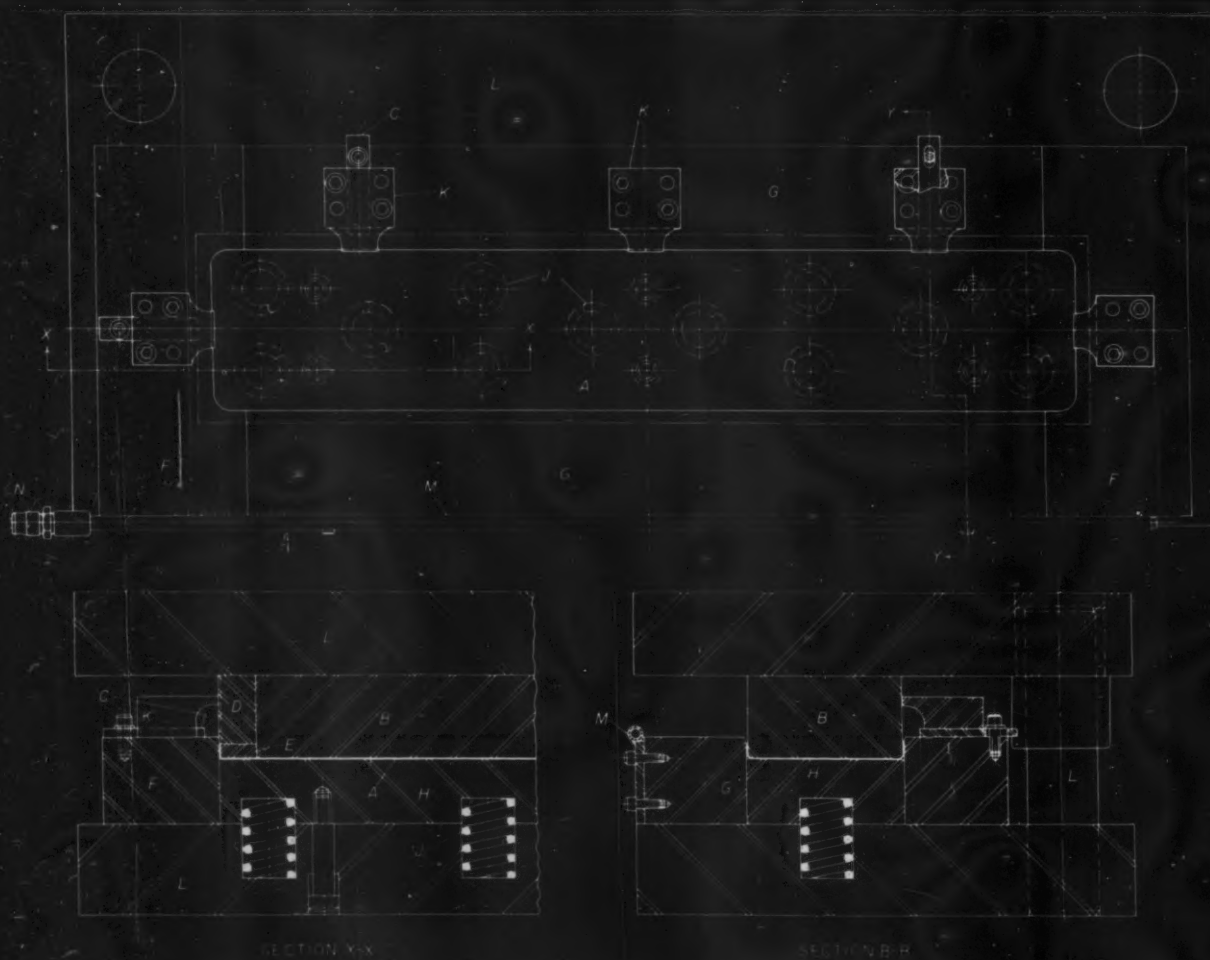
Simplified Corner-Draw and Pinch-Trim Die

WALTER L. STEIN, Kenosha, Wis.

The forming of large, seamless pan-shaped parts of a square or rectangular contour can usually be accomplished in a combination draw and trim die. If the part is shallow enough to be drawn in one stroke, a single die combining draw and pinch-trim features will successfully produce the part in one press operation. Pinch trimming

is necessary because of the ragged and uneven edges resulting in the areas where drawing occurs.

The combination draw and pinch-trim die here illustrated differs from one of conventional design in that it is inverted to simplify stripping of the large-size part A from the punch B. In use, a straight rectangular blank, previously sheared to



Die that forms the sides, and draws and pinch-trims the corners of a large but shallow, pan-shaped part.

length and width, is positioned in the die by means of three adjustable stops *C*, the blank being indicated by the broken line in plan view of the die. The ends are formed and the corners drawn by the pinch-trim punch members *D* and *E*, and the end and corner form-blocks *F*. Forming of the sides is accomplished by punch *B* and side form-blocks *G*. Pressure-pad *H* and coil springs *J* serve to retain the work-piece flat against the punch during the operation. On the up stroke of the ram, the work-piece is removed from the punch by five strippers *K*. The die is

constructed on a standard back-post die set *L*.

Chips are produced during the pinch-trimming operation and must be removed after each press stroke. To do this, an air line *M* was installed at the front of the die. One end of this pipe was plugged, and a series of outlet holes was drilled at the proper locations to permit a jet of air to blow all the chips from the die. To free the operator's hands and speed up chip removal, a foot type air valve was installed and connected to the air line with a rubber air hose and a quick-connect type coupling *N*.

Fixture Problem Solved with Novel Vise Jaws

F. A. ADAMS, Dayton, Ohio

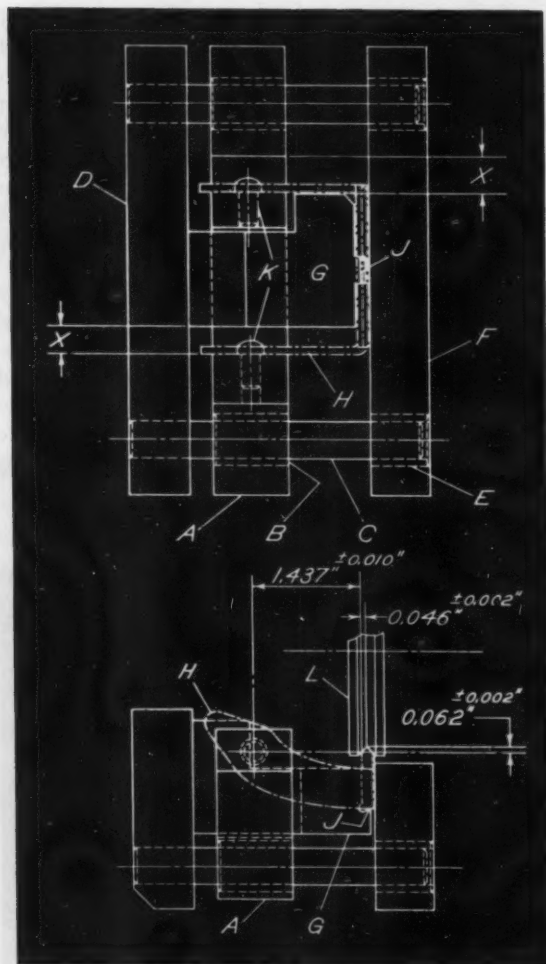
A sharp, V-shaped edge had to be form-milled on the work-piece here illustrated. Although a tolerance of plus or minus 0.002 inch was re-

quired for the 0.046- and 0.062-inch dimensions, the distance between the center of the two holes and the inner center surface of the yoke-shaped parts could differ from the nominal dimension by plus or minus 0.010 inch. To compensate for this variation, special mill-vise jaws incorporating a floating member were designed as shown and attached to a standard mill vise for the production of these work-pieces.

Floating member *A* is equipped with a pair of bushings *B* and slides freely along guide rods *C*. These guide rods are a press-fit in the stationary jaw *D*, but can slide in bushing *E* pressed in the movable jaw *F*. A block *G*, which is attached to the stationary jaw with screws and dowels, supports the bottom edge of the center portion of the work-piece *H* on a precision-ground surface *J*. In addition, two round locator pins *K* are secured in floating member *A* to support and position the work-piece by means of the holes. Member *A* is cut away to provide clearance for block *G* and the dimensions *X* are made sufficiently large to permit easy loading and unloading of the work-piece. The milling cutter *L* is positioned as shown.

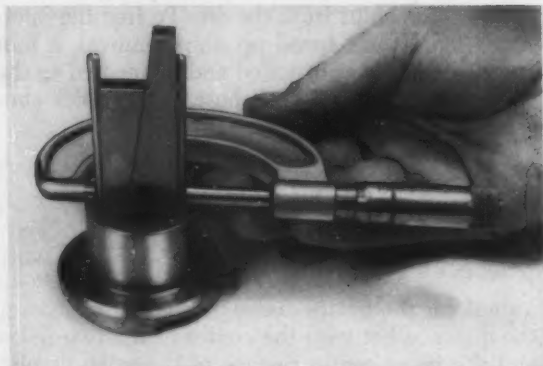
Tapped holes are provided in each of the special jaws for securing them to the jaws of a mill vise. Many variations of this arrangement may be devised for holding similarly shaped parts requiring the machining of surfaces having close horizontal and vertical tolerances.

U. S. metalworking plants managed a reduction of about \$5,000,000 in fire losses the past year, according to a report just released by the National Fire Protection Association. Total cost of fire damage and destruction to manufacturing facilities came to just under \$23,000,000 in 1958, against a figure of about \$28,000,000 for the previous year.



Special vise jaws that facilitate a milling operation on a yoke-shaped part.

SHOP KINKS



Grooves machined in adjustable parallels help to position wires for measurement of internal splines.

Modified Adjustable Parallel Holds Measuring Wires

H. J. GERBER, Stillwater, Okla.

The use of measuring wires or rolls will permit the accurate gaging of internal splines and gears. A problem involved in their use, however, is how to support the wires tightly while the measurement is being made. A standard adjustable parallel will eliminate this difficulty if modified to have a seating groove along each of the two opposed edges as illustrated.

Since such parallels are usually made of cast iron, either a vee or a cylindrical groove can easily be milled into each edge surface. The

grooves will hold the wires in alignment when the parallel is expanded to seat them tightly in the spline and while the micrometer measurement is taken. Several modified parallels of various proportions will facilitate gaging a wide range of sizes of splines and gears. Care must be taken to mill the seating grooves perfectly parallel.

Quick Check for Shear Gage Setting

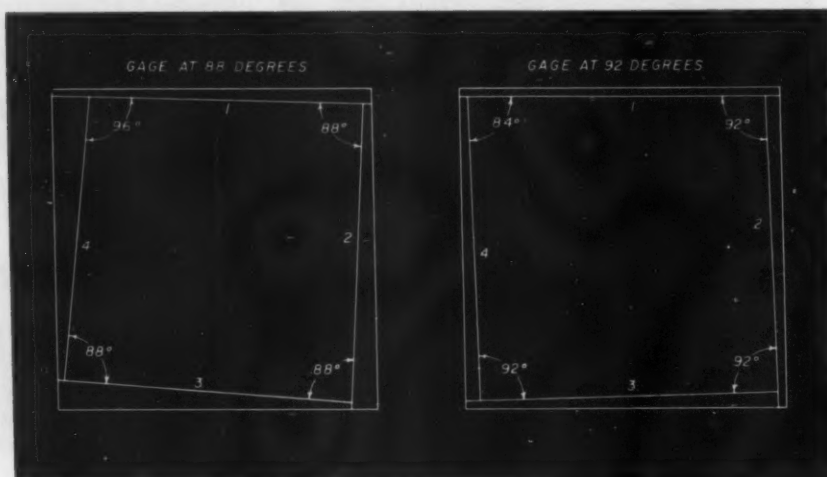
BUCKLEY SULLIVAN, Shaker Heights, Ohio

Whenever the blade in a squaring shear is changed or the machine gibs adjusted, it is advisable to check the position of the squaring gage. One method of doing this is to make an initial setting with a carpenter's square. Four cuts are then taken along the edges of a piece of sheet steel as illustrated, always banking the previously cut edge against the squaring gage. The original size and shape of the checking blank are of no importance.

If any out-of-squareness exists in the gage setting, this error will be magnified threefold at the corner between the first and last cuts. The included angle at this corner is measured with a protractor. A reading in excess of 90 degrees indicates that the gage is set at an angle smaller than 90 degrees; a smaller reading indicates a gage setting larger than 90 degrees.

In the example shown at the left in the illus-

Accuracy of the squaring gage on a shear can be checked by making four banked cuts around a piece of sheet stock in the sequence shown. Gage error will be multiplied threefold at the corner between the first and last cuts.



tration, the final reading was 96 degrees—6 degrees over the desired angle. This denotes a gage error of 2 degrees on the acute side, or a gage setting of 88 degrees.

An error in the opposite direction is shown at the right in the illustration. Here, the corner between the first and last cuts measures 84 degrees—6 degrees under the desired angle. Again a gage-setting error of 2 degrees is indicated, but this time it is on the plus side, or 92 degrees.

Work-Positioner for the Lathe

FRANK L. RUSH

It is often necessary to hold flat work-pieces on the faceplate of a lathe or in a four-jaw chuck for machining. While positioning these parts, the lathe operator must simultaneously juggle such equipment as clamps, chuck wrenches, and parallels. With the device here illustrated, work can be held flat against a faceplate or chuck and can be positioned in relation to the center axis of the lathe. This arrangement frees the mechanic's hands for clamping the work-piece.

The work-positioner consists of three basic parts which should be made for the lathe or job at hand. Body A is bored to fit snugly over the tailstock center B and is secured in place by two set-screws. A slot is cut in the body to guide the support bracket C, which is adjustable vertically.

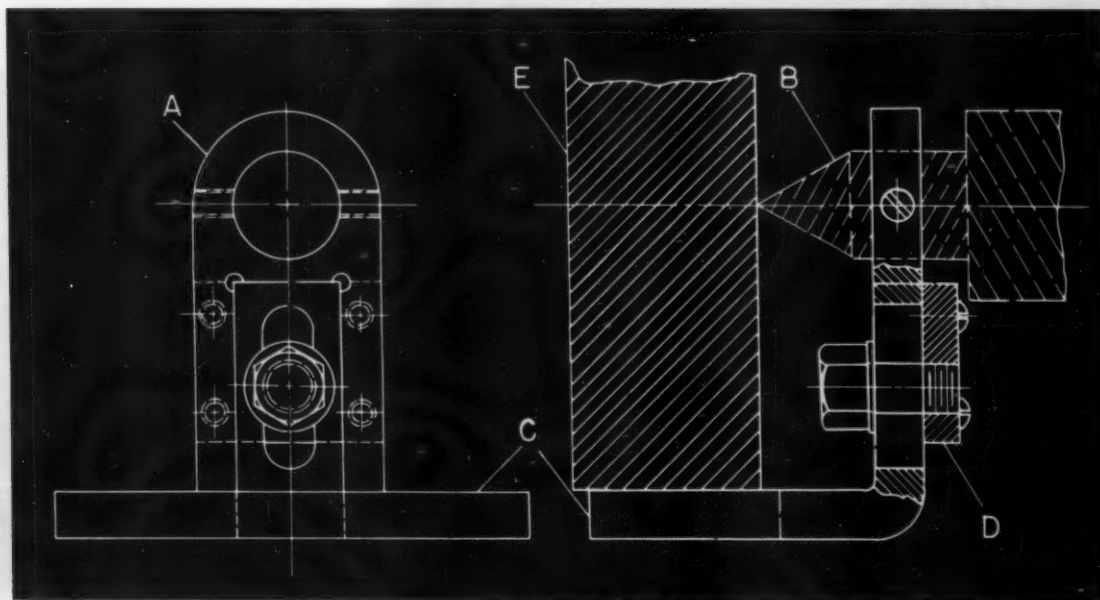
The bracket is held in position by means of a washer and a cap-screw that fits into a threaded hole in back-plate D. Four cap-screws secure the back-plate to body A.

In operation, the work-positioner is first secured to the dead-center by means of the two set-screws. Then the support bracket is set to the desired distance from the tailstock center, and firmly held in position by tightening the cap-screw. Next, the work-piece E is placed on the support bracket. With the tailstock clamped to the lathe bed, the tailstock spindle is advanced until the work-piece is pressed and held in position against the chuck or faceplate. After the part is securely clamped, the tailstock is retracted and the work-piece can be machined.

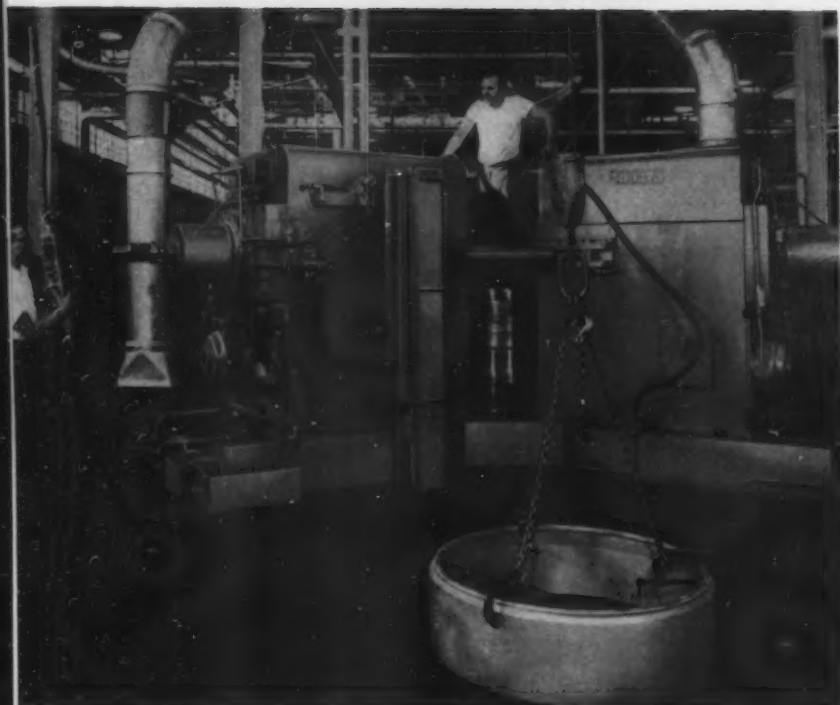
Instructional Models of Pneumatic Die Cushions

Working, instructional models of a new, universal pneumatic die cushion are being offered to trade schools, technical schools, and research laboratories by the Dayton Rogers Mfg. Co., Minneapolis 7, Minn. The models are of actual size and cut away to show the principle of operation. These die cushions are made in various sizes, developing from 1 to 500 tons ring holding pressure and can be used on any size power press. The instructional display models can be had free of charge upon request of engineering department of the educational institution.

Device that holds and positions flat lathe work against a chuck or a faceplate.
The lathe operator's hands are free to clamp the part.

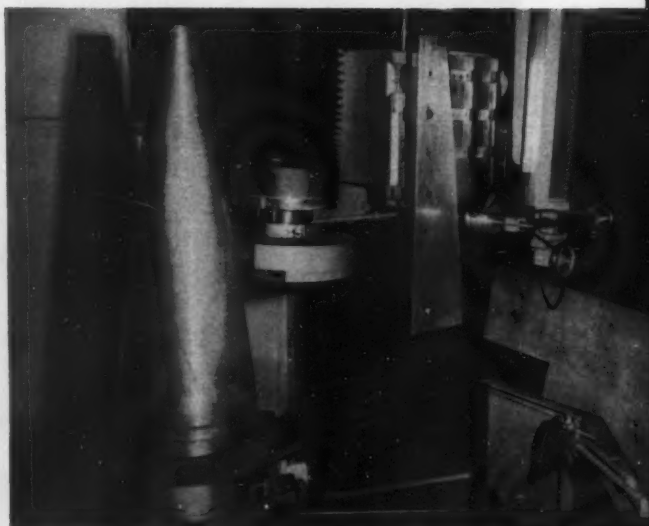


IN SHOPS AROUND THE COUNTRY



METAL FLOW—At Pratt & Whitney Aircraft, East Hartford, Conn., this giant Lodge & Shipley Floturn machine, reportedly the largest of its kind, turns out one-piece, weld-free rocket and missile cases. Vertical design permits work to move upward unobstructed as it is formed. Machine flows cylindrical shapes with diameters to 80 inches, lengths of more than 20 feet, and walls as thin as 0.015 inch.

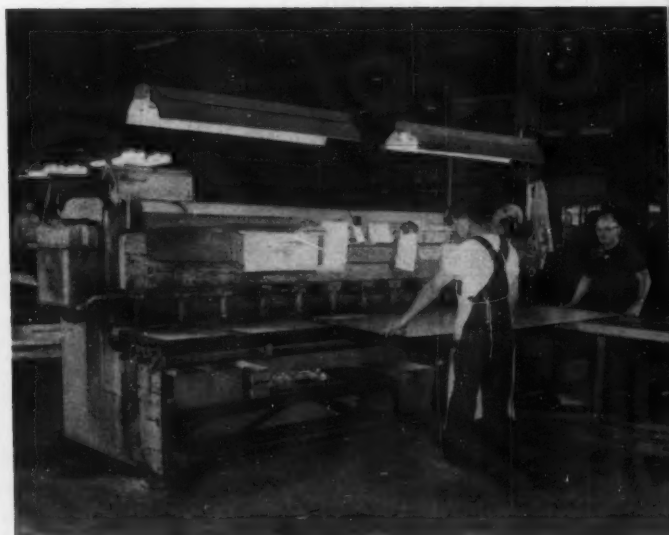
SHINY NOSE—A mandrel for the Nike Hercules nose cone is tracer-ground on a Bullard, at Douglas Aircraft, Charlotte, N. C. The grinding wheel, kept tangent to the surface, has a line contact and thus combines fast stock removal with smooth finish.



TOOTH CUTTER—A practice in electric-motor making to stamp out laminations is used by Black & Decker, Towson, Md., to notch teeth in saw-blade blanks. The work is supported on a fixture which indexes automatically in time with the press cycle, notching each tooth in succession.



FERROUS SCHOOLHOUSE—(Below left) First operation in the sheet-steel assembly line at the Calcor Corporation, Huntington Park, Calif., where schools of all-steel modular construction are being pioneered. The galvanized sheet here is sheared to width for a wall panel. (Right) Later, the sheet is formed in a series of press-brake operations. Stamped louver is for ventilation. Structures use double panels to form a 3 1/2-inch-thick wall equal in insulating value to a 12-inch masonry wall.

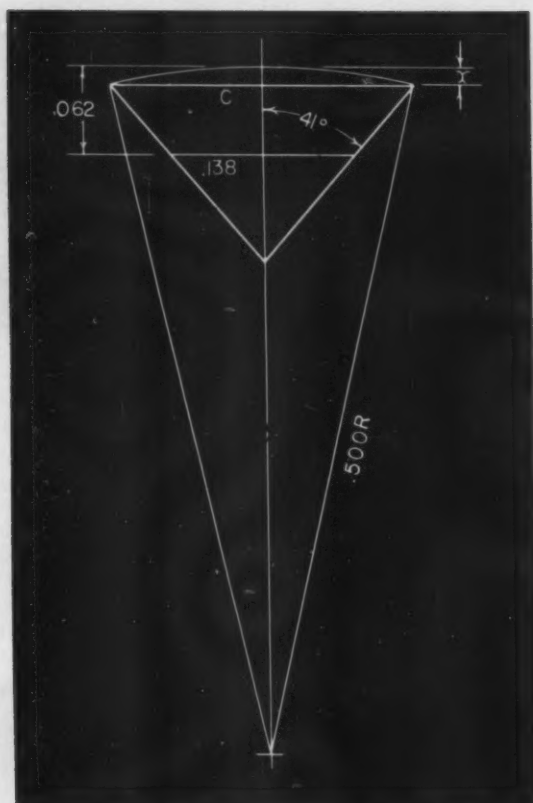




MACHINERY'S PROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL



Calculating a Milling Cutter Dimension

WILLIAM W. JOHNSON, Cleveland, Ohio

In the design of a special milling cutter it was required to find the dimension x from the data given in Fig. 1.

SOLUTION: (Using Fig. 2)

$$1. \quad b = 0.069 \cot 41^\circ = 0.069 \times 1.1504 = 0.0794$$

$$2. \quad m = 0.062 + b = 0.062 + 0.0794 = 0.1414$$

$$3. \quad \left(\frac{1}{2}\right)^2 = \left(\frac{c}{2}\right)^2 + \left(\frac{1}{2} - x\right)^2; \text{ or } \left(\frac{c}{2}\right)^2 = (1 - x)(x)$$

$$4. \quad \left(\frac{c}{2}\right)^2 = (m - x)^2 \tan^2 41^\circ; \text{ or}$$

$$x(1 - x) = (m^2 - 2mx + x^2) \tan^2 41^\circ; \text{ or}$$

$$(1 + \tan^2 41^\circ)x^2 - (1 + 2m \tan^2 41^\circ)x + m^2 \tan^2 41^\circ = 0$$

Substituting $m = 0.1414$ and $\tan^2 41^\circ = 0.7557$ from (2) and (4), respectively,

$$5. \quad 1.7557x^2 - 1.2137x + 0.01511 = 0$$

6. Equation (5) may be solved by using the standard quadratic formula,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{1.2137 - \sqrt{1.2137^2 - 4(1.7557)(0.01511)}}{2 \times 1.7557}$$

$$= \frac{1.2137 - \sqrt{1.4731 - 0.1061}}{3.5114}$$

$$= \frac{1.2137 - \sqrt{1.3670}}{3.5114}$$

$$= \frac{1.2137 - 1.1692}{3.5114} = \frac{0.0445}{3.5114}$$

$$x = 0.0127 \text{ inch.}$$

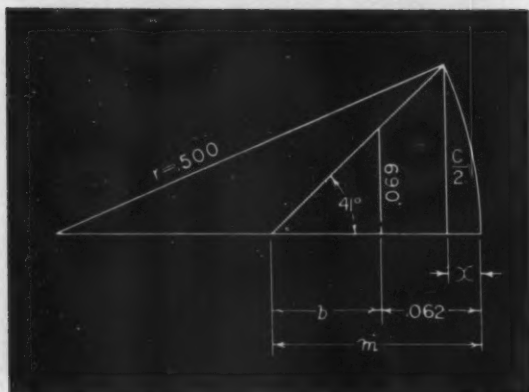


Fig. 1. (Top) Data from which dimension (x) on a special milling cutter is to be calculated.

Fig. 2. (Bottom) The distances (b) and (m) shown are needed in the solution to determine dimension (x).



Talking With Sales Managers

By **BERNARD LESTER**
Management Consulting Engineer

A Boy Asks a Question

A letter from a reader of this page—a high-school boy of eighteen preparing for college—asks how best to plan to become a sales engineer. "What subjects shall I take and how and where do I get started?"

Of course this timely letter deserved a reply. But the letter itself poses questions vital to every sales manager concerned with the growth and increased competence of his department.

We have reason to be alarmed by the dwindling number of engineering graduates interested in industrial-equipment marketing as a profession.

One reason for this is a misconception of what constitutes equipment marketing and sales engineering. In the popular mind, machinery is bought and applied by the user. The salesman in this field is often looked on only as a smiling face to link buyer and seller. Few people realize that marketing includes much more selling, and sales engineering, more than persuasion and order handling. Many have been surprised to learn that marketing takes a major part in determining what and how much equipment is to be built, and that the sales engineer often acts as a professional consultant in applying machinery.

The sales executive today must estimate the number of employees needed tomorrow to provide for growth. He also determines qualitative needs, for there are many instances of failure due to an unbalance of talents in an organization. Too much engineering and too little business skill, or vice versa, have handicapped many an organization.

But any attempt to get adequate manpower is blocked without a new supply of men who envision opportunity in distribution and sale, and have a hankering to get into it.

In scattered instances management has done a lot to publicize the character of machinery selling and the opportunities it offers. But with a steady increase in the branches of engineering work, a lot more should be done. Space technology, electronics, and a score of fresh activities attract young engineers.

Few engineering students realize the position marketing and selling technical products holds in

our economy. Its importance increases as product diversity grows. More than ever salesmen must be able to coordinate many types of equipment.

The categories of research, design, and production usually attract young engineers more than sales. Since they concern things and operations, the young candidate can picture himself at work on the job in these fields. But the image of selling we get as a child is not in harmony with the exact and practical conceptions of engineering. Too commonly in the mind of the student engineer, the sales engineer is merely an affable, well-dressed person carrying a brief case and well-filled wallet.

If you incline to doubt that we still spread this impression, just listen to a typical recruitment representative describe sales when he visits the technical school. The same sketchy and superficial description is true of much career literature we hand out to the student candidate.

Since there is a real need to explain equipment marketing and sales engineering as career opportunities, let us cite some steps to take.

Check what you are doing to inform engineering graduates about careers in machinery marketing and sales engineering. Do you describe the work and emphasize its importance, scope, and demands upon resourcefulness? Do you show that it is rewarding?

What sort of literature do you have available dealing with engineering sales work as a career? Is this material carefully distributed?

Besides promoting career opportunities within your own department, what is being done collectively through professional societies? The engineering societies incline to shun that which is commercial, and marketing and sales associations avoid discussing engineering applications.

A lot is yet to be done to inform teachers and students of the opportunities for young men in technical selling. Too much credit cannot be given to the National Machine Tool Builders' Association and the American Machine Tool Distributors' Association for what they do now to enlighten and train. Still broader organized effort will bring big returns.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Ex-Cell-O Numera-Trol Ultra-Precision Contouring Machine

An electronically controlled, ultra-precision grinding, turning, and boring machine capable of performing very complex operations has been introduced by the Ex-Cell-O Corporation, Detroit, Mich. The main-slide and cross-slide of this Style 922 Numera-Trol contouring machine are controlled in increments of 25 millionths of an inch, whether operated automatically through the tape-control system or by a manual control during setup. To achieve such exceptional accuracy the main-slide and cross-slide ways of the heavy, well-ribbed machine bed are hand-scraped to surface-

plate accuracy. Precision roller bearings, individually matched to within a few millionths of an inch and operating in oil, are incorporated in both the flat and V-ways. Similar precision is built into the slides themselves. The cross-slide weighs just under 1000 pounds, yet a pressure of only 5 1/2 pounds is necessary to overcome static inertia and only 5 pounds is required to maintain steady movement.

The lead-screws are recirculating-ball type antifriction screw-and-nut assemblies, supported at both ends in preloaded ball thrust bearings. Parallelism of the slide

ways is checked by an optical flat that is accurate to 1 1/2 millionths of an inch. The optical flat is checked periodically by the United States Bureau of Standards.

The new machine, Fig. 1, utilizes the well-proved concept of building-block construction, its versatility being considerably enhanced by interchangeable machining units. A typical group of components produced on one of these Numera-Trol machines is shown in Fig. 2. The precision turning and boring unit, Fig. 3, is self-contained except for the hydraulic power drive. When the machine is set up using this unit,

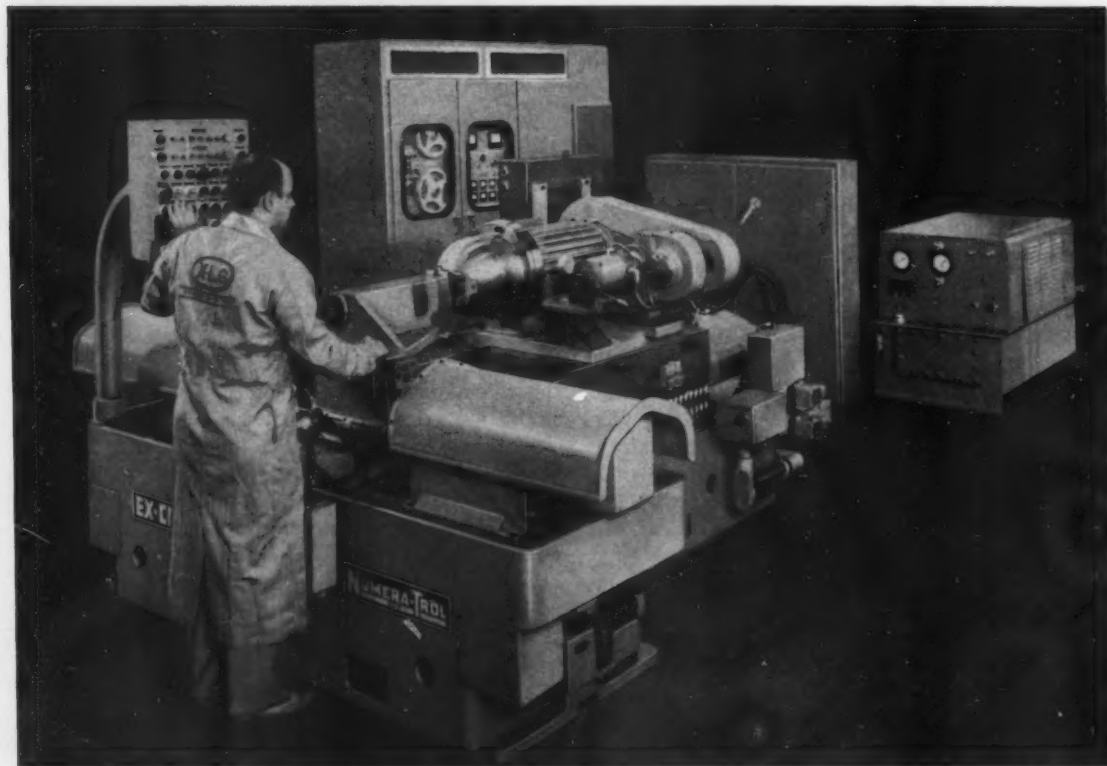


Fig. 1. Numera-Trol contouring machine developed by Ex-Cell-O Corporation set up for producing hemispheres

IN

SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON



Fig. 2. Typical group of components machined on Ex-Cell-O Numera-Trol

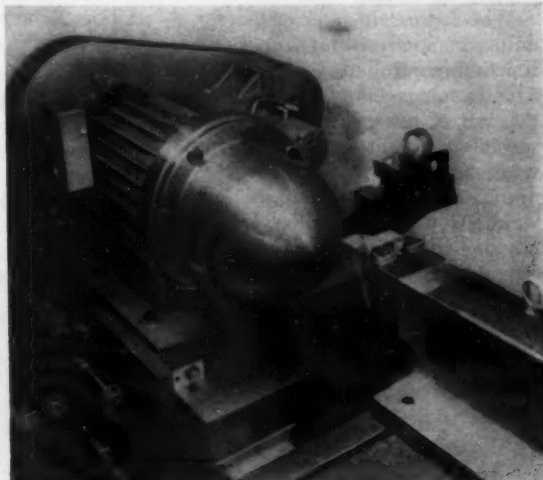


Fig. 3. Custom Ex-Cell-O turning and boring spindle with work-piece

super-precision boring and turning may be accomplished. The precision grinding assembly, Fig. 4, is also a self-contained building-block unit, readily interchangeable with the boring and turning unit. The mounting of this unit on the main-slide permits accurate template grinding and similar operations.

The custom-built precision spindle of the turning and boring head is driven by a variable-delivery hydraulic motor. This motor, seen adjacent to the front of the spindle body in Fig. 3, drives the spindle through a direct belt or through the reduction-gear unit shown. When turning the outside diameter or boring the inside diameter of hemispheres, the cutting speed is maintained at a constant rate by varying the spindle speed hydraulically to suit the changed conditions. Such an arrangement is essential in order to realize the super precision for which the machine is designed.

The unique reciprocating grinding head is capable of grinding extremely accurate template con-

tours and similar complex forms on flat stock. When used in conjunction with a rotary attachment mounted vertically on the cross-

slide, the grinding of circular cams is possible.

A special heavy-duty Ex-Cell-O precision spindle is mounted hori-

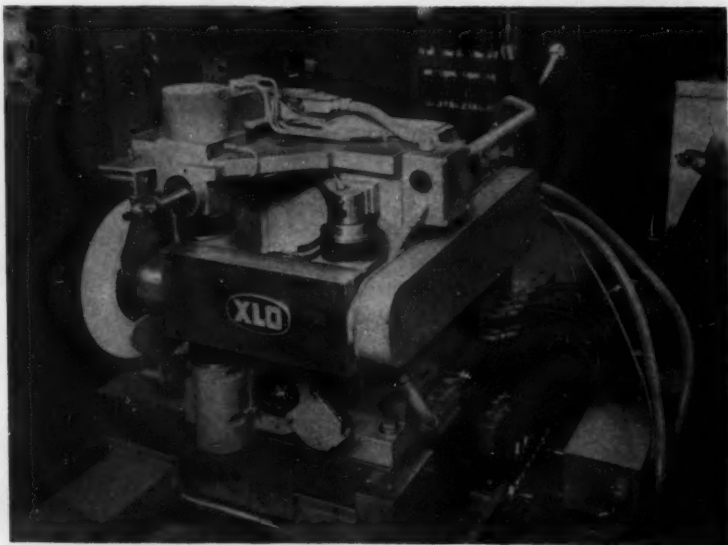


Fig. 4. Ex-Cell-O reciprocating grinding unit with automatic wheel dresser. This unit is interchangeable with turning and boring heads used on machine shown in Fig. 1

zonally at the front of the grinding head and driven from the rear by a 2-hp motor. The spindle is designed to reciprocate in a vertical plane, riding on pre-loaded ball bearings moving on two parallel guide bars. The reciprocating movement is power-operated and the length of stroke is adjustable.

Wheel dressing is provided for, either manually or as a periodic function controlled by the tape. The dresser is mounted directly to the rear of the grinding wheel on special precision roller bearing ways, adjusted for a no-play condition. The dresser may be advanced toward the wheel manually or hydraulically in increments ranging from 0.0022 to 0.0002 inch.

In the wheel-dressing operation, the normally reciprocating grinding wheel-spindle is brought to the center position of its stroke and hydraulically clamped. The dresser-slide then feeds forward by the amount to be dressed. After dressing, the main-slide is automatically advanced to compensate for the reduced wheel size. The grinding cycle is then resumed when called for on the tape.

When dealing with precision machining of an exceptionally high order, it is essential that the machine operate at a constant temperature of 72 degrees F. Heat from the electronic equipment contained within the tape-reading cabinets is effectively removed from the work area by ducts and the hydraulic power unit is water-cooled. Under these conditions it is possible to hold work tolerances of 0.0001 inch in routine production of templates and 0.0002 inch in contour-boring and turning operations.

Before commencing any tape-controlled cycle it is necessary to zero-in the slides to a predetermined start position. This is readily accomplished. Each slide is equipped with a hardened stainless-steel scale. Each scale is a replica of a scribed master measured and certified by the U. S. Bureau of Standards to 0.0001-inch maximum error over its entire length. Measurements are obtained through a direct-reading optical vernier, a spiral reticle providing

simple visual measurement to 0.0001 inch. Machining may commence when each slide is brought to zero start position.

Two rows of electronic counting tubes are provided on the control panel. During machining each row indicates numerically the respective dimensions by which the slides are removed from the start position. By movement of the hand

knobs at the lower left of the panel, it is possible to advance or retract either slide by increments of movement ranging from one tenth of an inch to 25 millionths of an inch. It is thus possible by simply dialing 25 millionths, to cause the 1 1/2-ton main-slide to advance or retract by just this amount.

Circle Item 565 on inquiry card

Light-Reflection Unit for Optical Projectors Provides Surface Illumination

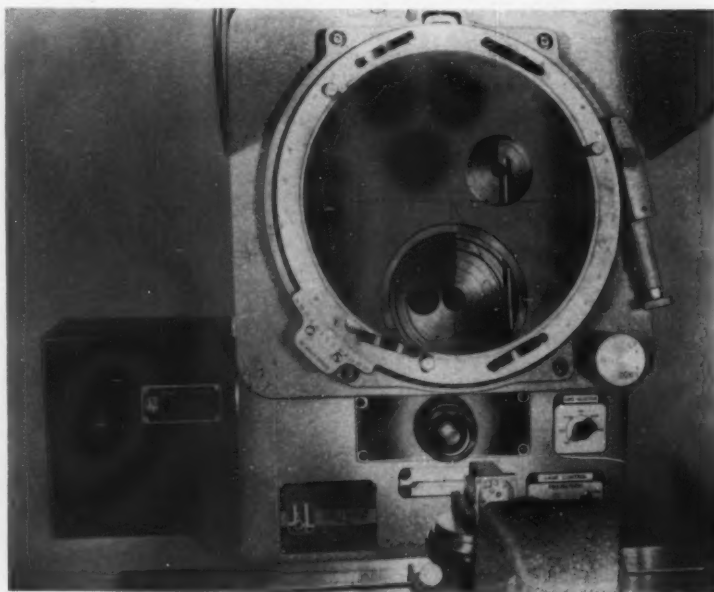
The Jones & Lamson Machine Co., Springfield, Vt., has announced a light-reflection unit for all its FC-14 and TC-14 optical comparators. This device has been developed to provide surface illumination for the inspection of parts by reflection. It is designed to produce the maximum amount of reflected light, regardless of the surface finish of the part being inspected. Even superficial surface scratches can be checked accurately. The device can also be used with excellent results for deep-hole inspection, as shown in the illustration.

A front surface, spherical reflector adds at least 55 per cent to the effective light given by a

1200-watt lamp. The entire unit is externally mounted. All heat is dissipated before entering the optical system of the comparator. A Pyrex, heat-resistant lens in the reflection unit prevents breakage due to shock. Depth of focus of up to 0.100 inch can be obtained and the image does not change size during focusing.

This is a high-intensity unit and is not limited to low magnification projection lenses. In fact, even metallographs can be taken, at 50X, to determine the depth of carbonization and grain structure. The new unit can be installed either at the factory or on machines already in the field.

Circle Item 566 on inquiry card



Jones & Lamson optical comparator equipped with surface-illumination unit for inspection by reflection

Sheffield Instrument for Measuring Temperature of Precision Parts and Gage-Blocks

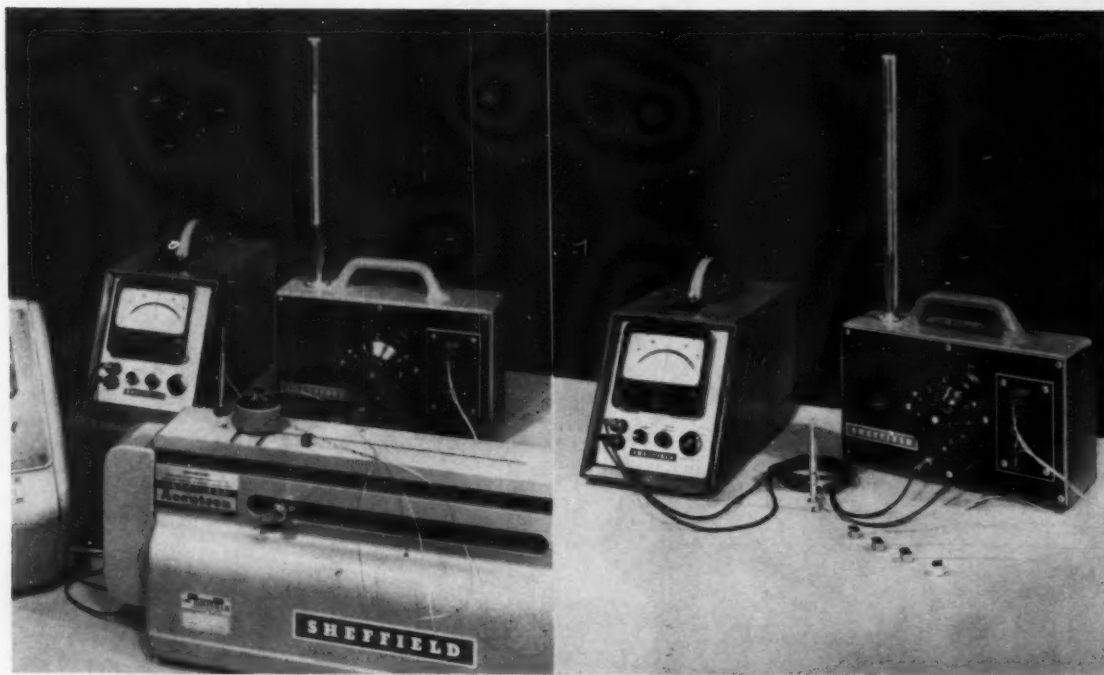
A portable electrical instrument that measures the temperature of precision parts, gages, instruments, and machines, as well as the surrounding air, with respect to a reference temperature and which indicates minute temperature deviations on a meter, is available from the Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation. Known as the "Tele-temp" temperature-measuring instrument, this equipment measures the deviation of temperature at five separate points of in-

errors caused by temperature variations in making precise measurements. One of its uses is to measure the precise difference between the temperatures of the dimensional standard used to set up the inspection instrument and the part being inspected.

Five copper-alloy (constantan) thermocouples with magnetic base serve as the temperature pickup units. One, an air-junction thermocouple, measures the temperature of the ambient air around the work-piece or instrument while the

quest for either centigrade or Fahrenheit measurements to suit special requirements.

A rotary switch on the face of the temperature-reference control unit enables the operator to select the desired thermocouple. The temperature-indicating meter has three available temperature amplifications and ranges to permit measuring fine, medium, and coarse temperature variations. The nominal amplifications and ranges supplied with the instrument are: High—1 degree C. = 40 divisions. Scale range 1.25 degree C.; Medium—1 degree C. = 20 divisions. Scale range 2.50 degrees C.; and



(Left) Sheffield "Teletemp" temperature-measuring instrument setup for measuring temperature and size of master ring. (Right) "Teletemp" instrument with indicating meter

spection independently at the turn of a dial. Deviation at each temperature-detection point is read on an accurate indicating meter as plus or minus within a temperature limit range of from 1/10 to 1/40 of a degree.

The instrument is designed for use in the gage laboratory, inspection room, or shop to indicate when parts are "cooled out," that is, reached temperature stability, or to eliminate or minimize the

others are placed on the elements to be sensed such as the work-piece, gage-block, inspecting instrument or machine. Each thermocouple has a 10-foot insulated lead. The thermometer is calibrated in 100 divisions per degree between the range of 19 degrees C. to 21 degrees C. One degree centigrade is equal to approximately 3 1/2 inches on the thermometer. Other temperature-range thermometers are available upon re-

Low—1 degree C. = 10 divisions. Scale range 5.00 degrees C.

The meter scale is equilinear each side of zero center. The "Teletemp" instrument is supplied with a calibrated chart that shows the precise temperature deviation to the meter reading of each of the thermocouples provided with the instrument.

The setup (shown at left in the illustration) is for measuring the temperature and size of a master

ring. The "Teletemp" instrument measures the precise difference between the temperatures of the dimensional standard used to set up the inspection instrument and the part being inspected. It also measures the temperature of the ambient air and the inspection instrument, which in this case is an Accutron internal measuring instrument. At the right is shown a Sheffield "Teletemp" temperature-measuring instrument with indicating meter, the temperature-reference control unit having a precision thermometer in a cold junction, and five thermocouples, one of which is an air junction.

Circle Item 567 on inquiry card

Pangborn Heavy-Duty Blast-Cleaning Barrel

A heavy-duty Rotoblast blast-cleaning barrel having a capacity of 15 cubic feet has been announced by the Pangborn Corporation, Hagerstown, Md. This bar-

rel is designed to provide the first heavy-duty type barrel of medium size for cleaning large castings weighing up to 500 pounds each. It will handle a batch load of 2700 pounds and is available with standard controls or in semi- or completely-automated types. The unit incorporates a 30-hp Rotoblast wheel which delivers 50,000 pounds of abrasive per hour for rapid cleaning at low cost. The interior has "wear-resist" steel plates as standard equipment. These long-wearing, super-tough alloy-steel plates are said to last up to 100 times longer than mild-steel plates, insure low maintenance costs, and require less down time for parts replacement.

The rugged, close-fitting slat type work conveyor incorporates new design refinements that make it virtually jamproof and quiet-running. Conveyor tension is quickly and easily adjusted from outside without dismantling or unloading. Should the conveyor jam while running in either direc-

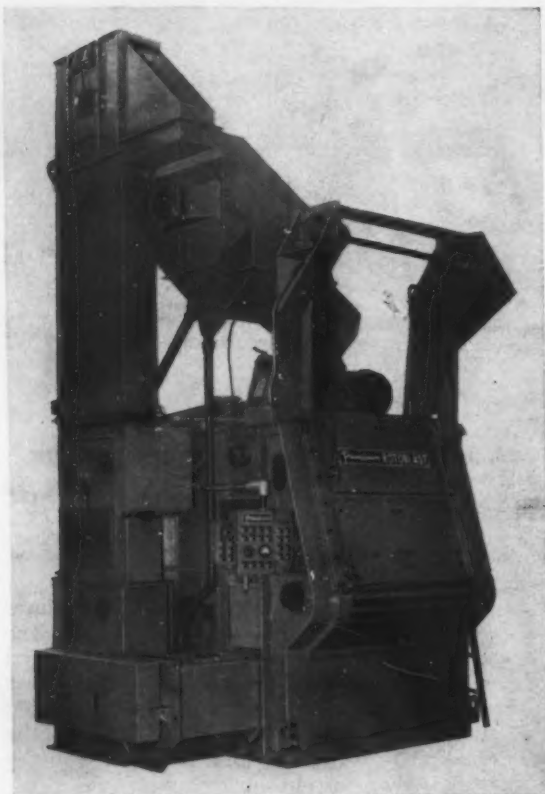
tion (blasting or unloading), an automatic torque arm immediately disengages the shaft-mounted reducer drive and stops the work conveyor until the jam is cleared and the torque arm manually engaged.

The blast cabinet is constructed of welded steel plates, completely sealed and dust-tight. The jamproof, two-piece barrel door travels on rollers in labyrinth-sealed guides which contain no gaskets or rubber seals. The door and guides are wider than the barrel opening. This eliminates damage to the guides during loading and prevents abrasive from entering the labyrinth seals. When closed, the door is abrasive- and dust-tight.

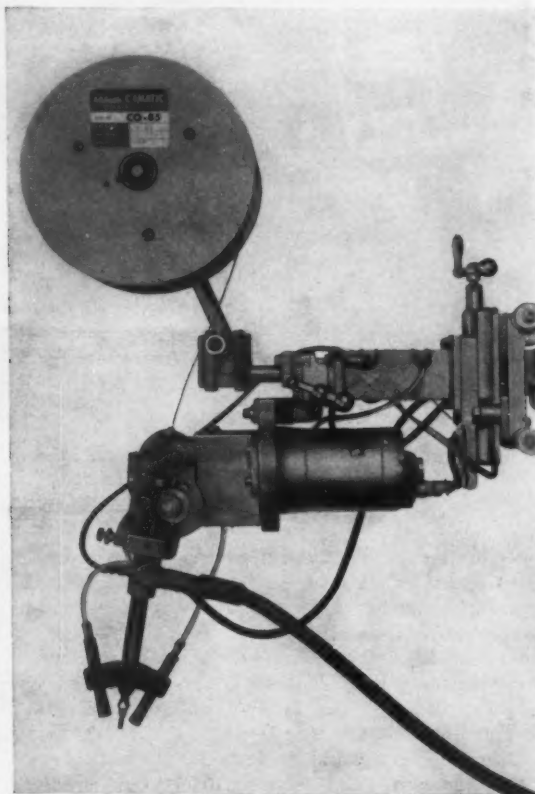
Circle Item 568 on inquiry card

Automatic Welding Equipment

Weld wire is fed continuously without lag or slowdown at high-speed rates by fully automatic CO₂



Heavy-duty Rotoblast blast-cleaning barrel announced by the Pangborn Corporation



Welding equipment introduced by Welding Products Division, A. O. Smith Corporation

welding equipment introduced by the Welding Products Division, A. O. Smith Corporation, Milwaukee, Wis. Featured in this CP C-OMatic packaged welder is an automatic welding head coupled with a 100 per cent duty cycle, 600-ampere constant-potential power source.

The equipment uses small-diameter wires specifically designed for welding mild and medium carbon steels. According to the manufacturer, it provides high-quality weld metal, high deposition rates, deep penetration, low-hydrogen weld metal, visible arc, and requires no slag removal. It can be used for single- and multiple-pass butt welds, flat and horizontal lap

welds, positioned and horizontal fillet welds, and circumferential butt and fillet welds.

Completing the equipment package are: a heavy-duty, water-cooled nozzle with external shielding for heavy production use; three-position mount; and an attached reel mount for holding spooled or coiled wire.

The 600-ampere, constant-potential power source provides infinitely variable voltage control from 0 to 45 volts. Voltage is set by "coarse" and "fine" adjustment dials on the front panel. A third dial provides five different slopes to permit selection of the optimum arc for each application.

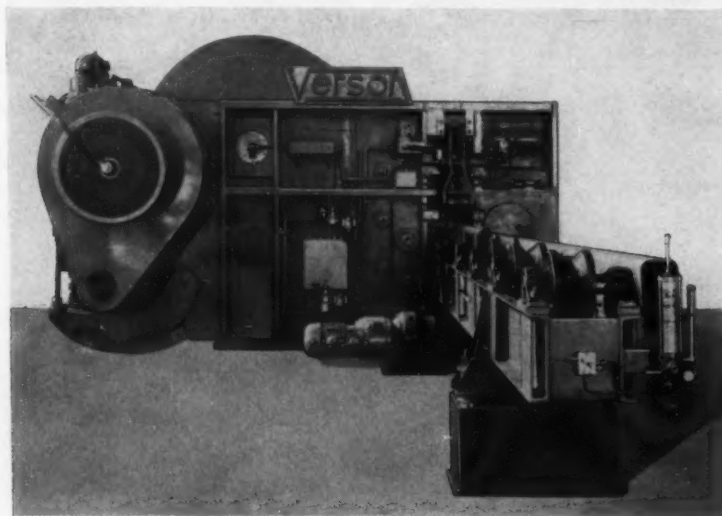
Circle Item 569 on inquiry card

Heavy-Duty Bar and Billet Shear

A heavy-duty bar and billet shear has been developed by Verson Allsteel Press Co., Chicago, Ill., which has the capacity for shearing 4-inch bars of SAE 5140 steel having a tensile strength of 115,000 psi. Its capacity is rated at 700 tons, 1.9 inches up at point of shear. The production rate is 32 spm (strokes per minute) with a 4-inch stroke at point of shear. It will shear billets up to 6 inches long at this speed or an 8-inch long billet at 25 spm. The weight of sheared billets is held to a tolerance of plus or minus 3 ounces. Shear-cut length tolerance is plus or minus 0.020 inch. Minimum

lengths that can be sheared are 75 per cent of the distance across flats of round-corner square stock or 75 per cent of the diameter of round stock.

The machine is completely automatic in operation. It is provided with power feed conveyor, length gage, outboard support, hold-down, and automatic lubrication. Adjustments can be made to provide for continuous, single-stroke automatic, once-automatic once-shear-only, and inch-shear-only operation. Manual operation can be selected for the hold-down, outboard support, and length gage to permit using these accessories



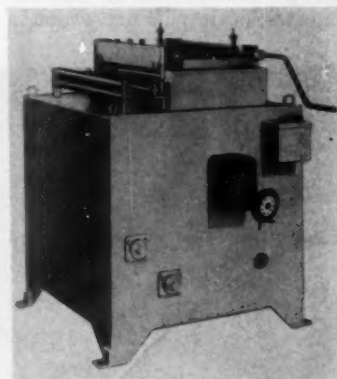
Verson heavy-duty bar and billet shear

without running the shear. The shear measures 134 inches in height and 204 inches front to back by 116 inches right to left. It weighs approximately 150,000 pounds and is of rugged all-steel construction.

Circle Item 570 on inquiry card

Feeding and Straightening Machine

A combination feeding and straightening machine that combines the features of a roll straightener with those of an automatic feeding machine is announced by the Benchmaster Mfg. Co., Gardena, Calif. This machine is available with either one or two electromagnetic-drive clutches controlled by an adjustable-feed length-measuring "timer." The machine is capable of feeding uniform, controlled lengths of coiled, flat, or strip stock, simultaneously passing them through a series of powered rolls, thus producing flat



Benchmaster combination feeding and straightening machine

stock free of curl or camber. On the standard models the timer can be set to produce virtually any length up to 60 inches at which time the drive clutch disengages and the timer automatically resets itself for a repeat cycle. By adding a timer bypass circuit, work of any length can be fed.

This combination feeding and straightening machine is available in two styles, one having a variable-speed drive which adjusts to the desired feed rate, and the other having a fixed-rate feed. Where

normal accuracy is required in the feed length, the single-clutch model is used. Where feed length must be held to a closer tolerance the double-clutch unit is preferred, since this model eliminates the usual feed accuracy difficulties by

reducing the speed of feed to one-seventh of its pre-set speed, just before the end of the feed stroke. Even greater accuracy can be had by using an electric limit switch in conjunction with the timer.

Circle Item 571 on inquiry card

Snyder Index Machine for Processing Control Arms

A special trunnion type machine tool, which utilizes in-process gaging and thread-rolling techniques to finish both ends of forged-steel steering knuckle control arms for trucks at a rate of 144 parts per hour, is announced by the Snyder Corporation, Detroit, Mich. This six-station machine has an index fixture that holds two parts in each station. Thus, two finished parts are completed with each index of the machine. Part unloading and loading at the first station is done during the machining cycle.

One of the most interesting features of this machine is the gaging and thread-rolling operation that takes place at the sixth station. The diameter of a part on which a

thread is to be rolled is a very critical dimension. If it is too large, the thread rolls may be broken. If the diameter is too small, a thread of insufficient form will be produced. For these reasons, an in-process gaging operation is incorporated in connection with the thread-rolling cycle at the sixth station. The thread-rolling function is performed by Acme die-heads traversed by dual, motorized lead-screw units mounted on top of each trunnion support.

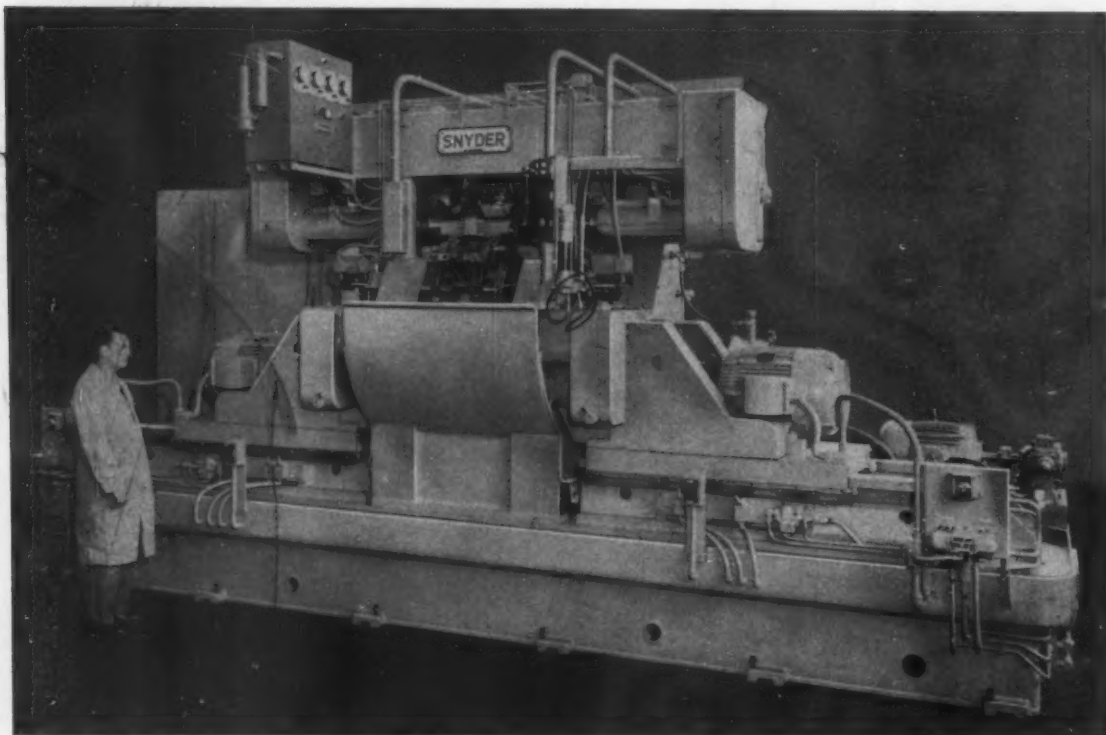
Before the threads are rolled, hydraulic-cylinder-operated, scissors type toggle mechanisms cause air snap gages to check the diameters of both ends of both parts at the sixth station. If the diameters of both parts are correct, the

thread-rolling sequence is initiated. If either part fails to pass the inspection check, the machine is shut down automatically.

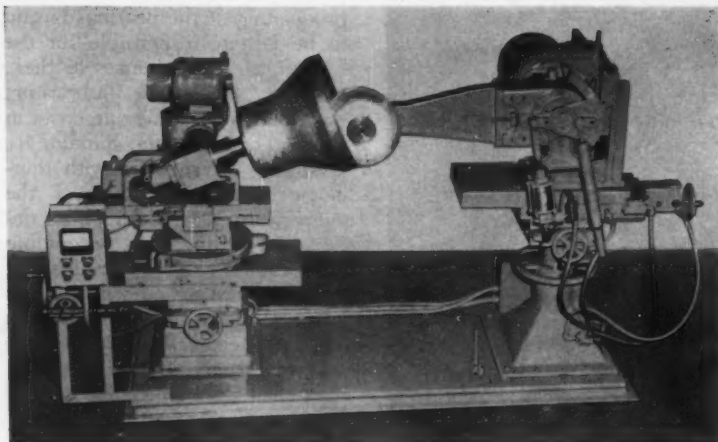
The station operating sequence for the production cycle for each part end is as follows: first station, unload and load; second station, spot-drill, face, and chamfer; third station, rough-hollow-mill the thread diameter; fourth station, finish-hollow-mill a diameter adjacent to the thread portion; fifth station, finish-hollow-mill the thread diameter; and sixth station, gage thread diameter and roll threads.

The new machine, which has a fabricated steel base, includes a variety of Snyder standard building-block units. Among these are the trunnion assembly, the index mechanism, and the two 40-hp, way type units that carry six-spindle heads. Hydraulic power for fixture indexing, gage advance, and machining-unit travel of the electrically operated, hydraulically controlled machine is provided by a separate hydraulic pump and tank unit.

Circle Item 572 on inquiry card



Special six-station trunnion type machine tool that utilizes in-process gaging and thread-rolling techniques, built by the Snyder Corporation



Acme standardized reflector polishing machine

Acme Polishing Machine

A standardized automatic polishing machine of improved design for finishing a wide variety of shapes and sizes of reflectors and bowl-shaped metal parts is now available from the Acme Mfg. Co., Detroit, Mich. This machine will finish reflectors, oval shapes, bubble type surfaces, conical, cylindrical, and bowl shapes in a fully automatic operating cycle. It can be used on parts made of aluminum-clad material, stainless steel, low-carbon steel, copper, and brass.

A unique feature of the machine is the automatic control of finishing-wheel pressure to prevent excessive pressures encountered when contact surfaces change from large to small radii as in oval reflectors. Air-line pressure directed to the cylinder that controls the wheel contact pressure is automatically varied by a cam and switch arrangement to suit part-configuration requirements. Another feature is the automatic reversal of wheel rotation during the finishing cycle. This enables both cutting and coloring operations to be performed in one or the same work cycle.

In the machine illustrated, which is specially adapted to the polishing of reflectors for street lights, hair dryers, and large lighting fixtures, the polishing wheel is powered by a 7 1/2-hp motor. The work-spindle is driven by a 1/2-hp motor. The machine occupies a

floor space approximately 3 by 9 feet and has an over-all height of approximately 52 inches. Motor horsepower and other machine details can be varied to suit specific part polishing requirements of the user.

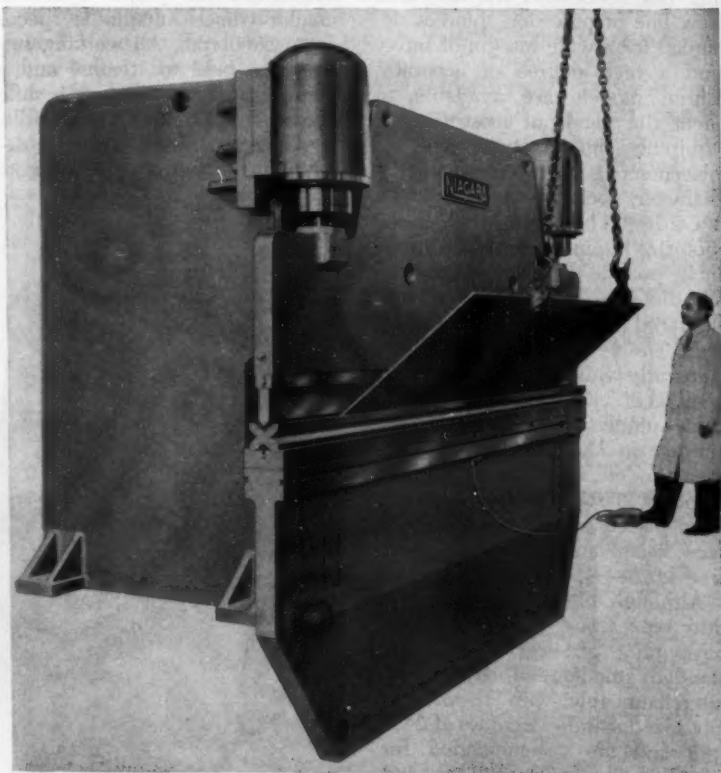
Circle Item 573 on inquiry card

Niagara Hydraulic Press Brakes

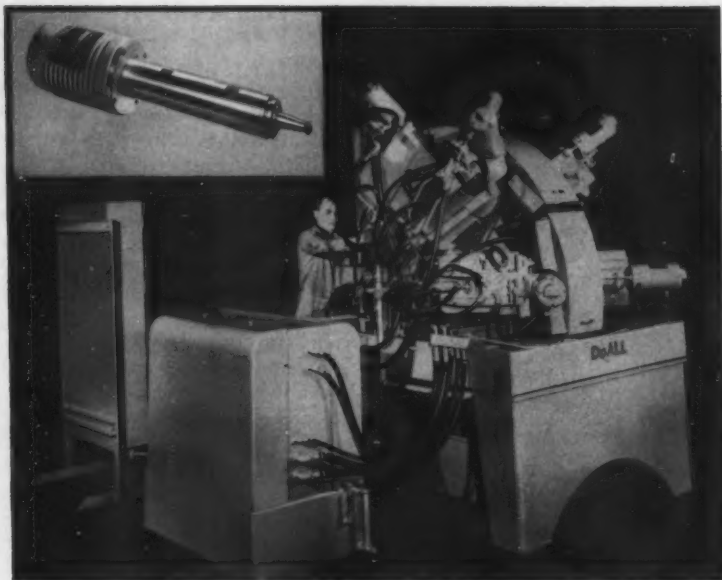
A line of hydraulic press brakes with capacities ranging from 200 to 1000 tons is being marketed by Niagara Machine & Tool Works, Buffalo, N. Y. Identified as Series HD, these machines are available in forty-four models to cover a broad span of bending requirements. Bed and ram lengths range from 4 feet 8 inches to 24 feet. The line supplements Niagara's mechanical press-brake series which has a range of 15 to 1500 tons.

Outstanding features include: unitized hydraulic system; rugged hydraulic cylinders keyed to frame for accurate alignment; unique ram leveling and tilt control, requiring no complex hydraulic or electronic devices; self-aligning ball joints with renewable seats; laminated, nonmetallic ways; deep, rigid bed interlocked to frame; front-operated, lower limit ram adjustment; adjustable top- and bottom-stroke stops; and portable, multiple-position foot switch.

Circle Item 574 on inquiry card



Hydraulic press brake of new line introduced by Niagara Machine & Tool Works



DoALL precision grinder spindle (insert) of newly developed line and machine with six of these spindles employed in production of television tubes

DoALL Machine Tool Spindles

The DoALL Co., Des Plaines, Ill., has announced the first of a new line of precision spindles designed for a wide margin of safety and a high degree of accuracy. Three models are available to meet the needs of most original equipment manufacturers and replacement users; a 3-inch outside-diameter, belt-driven spindle; a 1 1/2-hp, 3-inch outside-diameter motorized spindle; and a 1-hp, 3-inch outside-diameter motorized spindle. The belt-driven model is operated at speeds up to 5000 rpm. The 1-hp spindle is mounted integrally with its motor which has a speed of 3450 rpm. These are the same spindles that were developed for use in DoALL precision surface grinders. In the design of these spindles particular emphasis has been placed on accuracy, fine surface finish, and a long, trouble-free life.

Although all three are of heavy-duty type, using double-row bearings, they are no larger than standard spindles and may be used interchangeably with them. The motorized spindles operate at 3450 rpm and are recommended for wheel sizes up to 7 by 1/2 by 1 1/4 inches or 8 inches for wheels with

bonds rated for higher than normal peripheral speeds. The belt-driven spindle can carry even larger wheels with the belt pulleys arranged for the proper speed or smaller wheels at spindle speeds up to 5000 rpm. All working surfaces are held to "tenths" and a runout of only 0.0002 inch is sufficient for rejection of any spindle.

A special assembly machine developed to assure very accurate

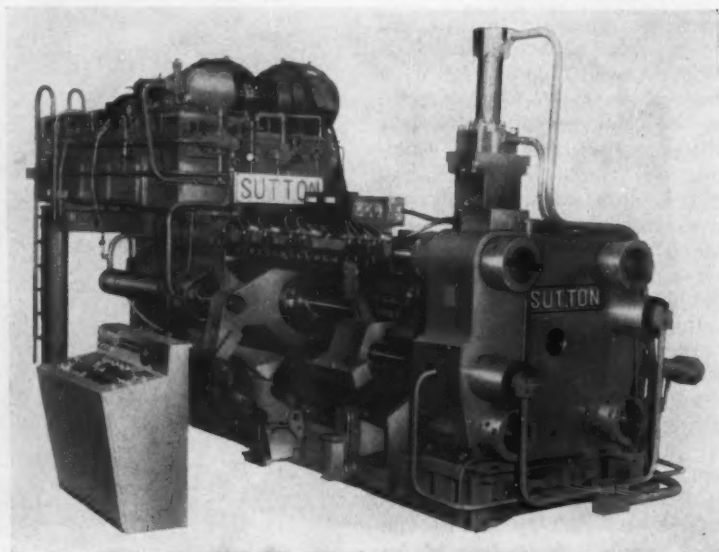
pre-loading of the bearings is said to be largely responsible for the exceptional performances of these spindles. Even the lubricating grease is carefully measured out in grams. The assembled spindles are run-in on a test stand with thermometers attached to check the temperature rise. Although 50 degrees C. is the usual acceptable temperature rise, the pre-loading of the DoALL spindle is adjusted to run at a maximum temperature rise of 20 degrees C.—a factor contributing to uniformly accurate work. The test is completed between four and eight hours when a stable temperature has been reached.

Circle Item 575 on inquiry card

Hydraulic Extrusion Press

A complete line of extrusion presses is now offered in both horizontal and vertical designs for all modern ferrous and nonferrous metals by the Sutton Engineering Co., Pittsburgh, Pa. The Sutton 1250- to 1500-ton horizontal hydraulic extrusion press shown here was built for use in the Youngstown, Ohio, plant of the Sarmar Aluminum Co. It will be used for the extrusion of aluminum sections for the building industry. This press is said to have increased output by 40 per cent.

Circle Item 576 on inquiry card



Sutton 1250- to 1500-ton horizontal hydraulic extrusion press

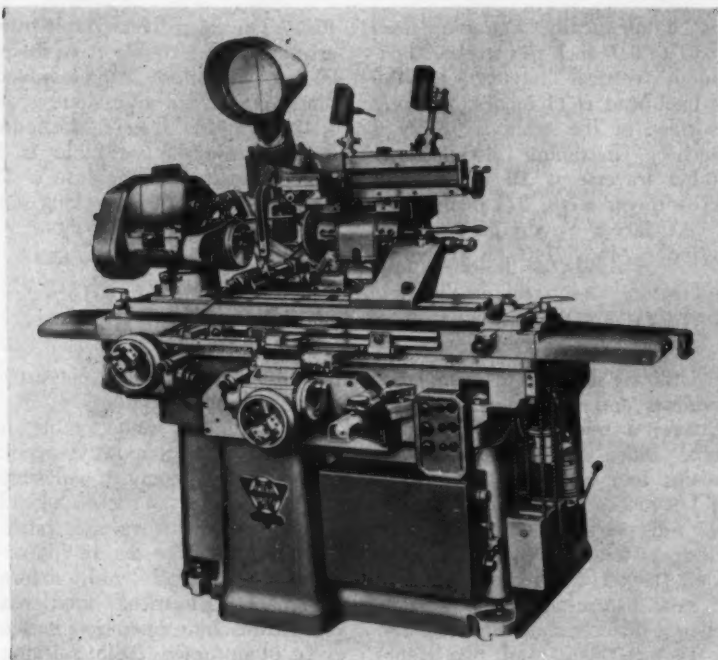


Fig. 1. Jones & Shippman machine being sold by Micromatic for grinding circular form-tools

Micromatic Markets Jones & Shipman Grinders

Micromatic Hone Corporation, Detroit, Mich., is now the exclusive sales and service source in the United States and Canada for grinding machines manufactured by its associate company, A. A. Jones & Shipman of Leicester, England. Included in this line of machines is a Model 310 cutter and tool grinder which has a distance between tailstock centers of 19 inches. The swiveling machine table has a longitudinal traverse of 17 1/2 inches and a cross traverse of 7 3/8 inches, with a working surface of 29 1/2 by 4 1/4 inches. The wheel-head has a vertical adjustment of 8 inches, a circular adjustment of 350 degrees, and two speeds.

Work-pieces up to 12 inches in diameter by 24 1/2 inches long can be accommodated on the Model 1215 circular form-tool grinding machine shown in Fig. 1. Cylindrical formed work, parts having unusual contours, or lengthy work-pieces requiring angular faces can be produced on this cylindrical grinder. Three wheel-head feed rates are provided: a fast feed of 1 ipr (inch

per revolution) of a main hand-wheel, a normal feed rate of 0.1 ipr of a secondary handwheel, and a fine feed of 0.001 ipr of a knob.

The main table of this cylindrical grinding machine is equipped with a similar arrangement of three feed rates and system of secondary reference units. Two wheels are

provided (one at either end of the spindle), and they can be used in a swiveled position. A longitudinal table traverse of 22 inches and wheel-head cross-feed adjustment of 10 1/4 inches are available. External wheel speed is 2600 rpm, and internal wheel speed is 12,000 or 18,000 rpm.

A Model 1212 cylindrical grinding machine is hand-operated for finishing small quantities of parts to extreme accuracy. Wheel-head infeed is graduated in increments of 0.000020 inch (reduction in diameter), and surface finishes of less than 2 micro-inches can be obtained in production. Swing over the machine table is 5 inches in diameter, and the grinding length is 12 inches between centers. Maximum traverse of the swivel table is 13 1/2 inches. A direct-current motor on the work-head drive can be supplied with six different voltages.

Models 1300, 1305 (Fig. 2), and 1310 precision grinding machines provide shockless table reversal at all speeds and are capable of producing surface finishes of 1 micro-inch. All models are available with a fixed wheel-head suitable only for external grinding of cylindrical and taper work, a swiveling wheel-head which carries both external and internal grinding wheels, or a rise-and-fall type, swiveling wheel-head having both external and internal wheels for all types of tool and cutter grind-

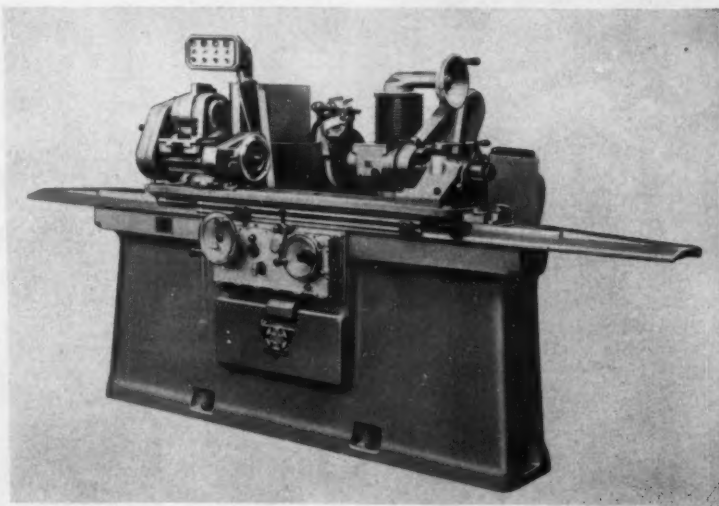


Fig. 2. Precision grinding machine can be equipped with any one of four different wheel-heads

ing. Also, Models 1300 and 1305 only can be provided with a wheel-head designed for grinding acute external and internal tapers. Mounted on a double swivel back-slide, this head allows the wheel to be fed at the angle of the slide setting. Wheels may be mounted at either or both ends of the spindle without changing driving belts.

Hydraulic traverse permits infinite variation of the table speed on these grinders. Automatic in-feed of the wheel-head is operated at every reversal of the table, and can be varied from 0.0001 to 0.0006 inch by means of a control knob. Model 1300 permits grinding parts up to 10 inches in diameter and 27 inches long between centers, and has a working area of 123 by 57 inches. Model 1305 provides for work-pieces up to 10 inches in diameter and 40 inches long, and has a working area of 175 by 63 inches. Model 1310 grinds work up to 8 inches in diameter and 18 inches long.

Model 540 hydraulic surface grinder features simple and convenient controls. Table traverse rates are variable from 5 to 40 feet per minute, and the cross-feed

is automatically variable from 0.01 to 0.07 inch per stroke. Maximum vertical traverse of the wheel-head is 11 inches. Working surface of the table is 18 by 6 inches, maximum longitudinal table traverse is 19 inches, and cross-traverse is 6 3/4 inches.

A larger hydraulic surface grinder, Model 1400, is shown in

Fig. 3. On this machine, table traverse speed is variable from 10 to 60 feet per minute. The cross-feed range per stroke at each reversal is 0.007 to 0.070 inch. Maximum cross-traverse of the table is 8 inches, longitudinal traverse is 25 inches, and the table working surface measures 24 by 7 inches.

Circle Item 577 on inquiry card

Dial Type Machine for Processing Steering Rods

Utilizing standard machine components and tools plus a special fixture, a new three-station dial type index machine drills and reams four holes to a depth of 4 1/2 inches in each of 443 steering rods per hour. This equipment, designed and built by F. Jos. Lamb Co., Detroit, Mich., requires only a new fixture and hole pattern change to accommodate new parts.

Two left-hand and two right-hand parts are placed in the fixture. Each part seats on two vees and is clamped by individual floating type self-equalizing members. A hydraulic rotary coupling provides each station with a separate clamping circuit. Thus, manual loading and unloading of parts is

performed during the twenty-two-second machining cycle.

The standard index table is equipped with a positive-action shot-pin for accurate indexing. Heavy guide bars in the work-head extend through the traveling bushing plate into the fixture for accurate work-head and fixture alignment. Electrical interlocks prevent machine operation in the event of improper table indexing or part clamping.

The vertical column supports the Lamb standard plate type drill-head. Coolant floods the dishd bushing plate, keeping tools and work cool. The fixture is designed for good chip removal.

Circle Item 578 on inquiry card

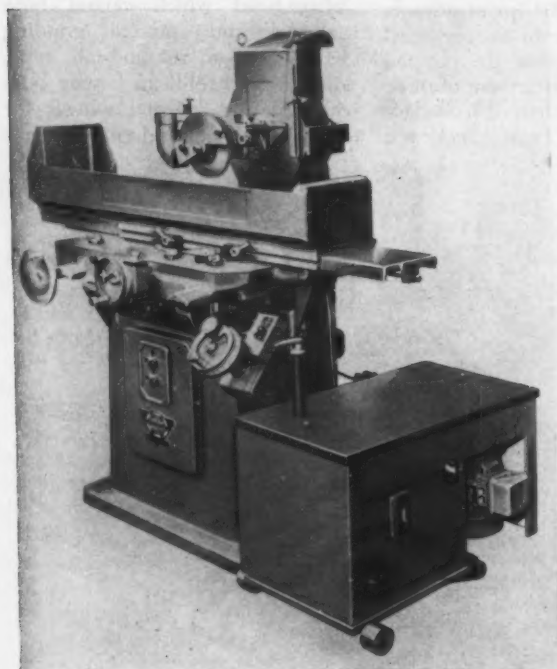
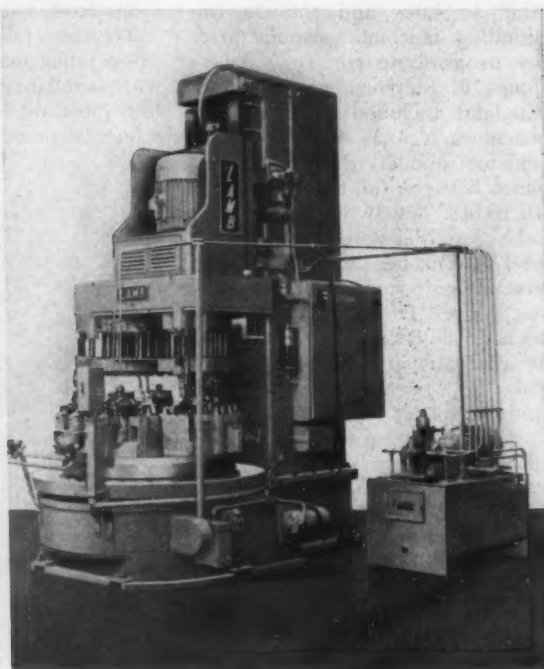
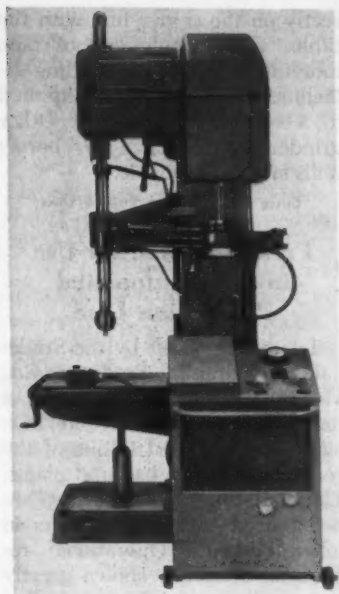


Fig. 3. Hydraulic surface grinder has a table working area of 24 by 7 inches



Lamb three-station dial type index machine equipped to drill and ream steering rods



Drill press equipped with Beckett-Harcum hydraulic feed

Beckett Self-Contained Hydraulic Feeds

Completely self-contained hydraulic drill-press feeds designed and built by the Beckett-Harcum Co., Inc., Wilmington, Ohio, are now available to industry. These complete, packaged units are designed to provide an economical means of automating large, older

type drill presses, having capacities for drilling up to approximately 1 1/2-inch holes in steel. This includes machines adapted for high-production drilling and allied work. The illustration shows the Beckett hydraulic drill-press feed installed on a large drill press. The unit consists of a heavy-duty power-transmission arm and a console mounted on wheels for easy portability. The console houses the control valves, hydraulic tank, and pump.

The Beckett "Hi-Cyclic" hy-

draulic solenoid valve control system used in these units provides a completely variable and quickly adjustable approach speed, slow-down for work entry, return speed, and working thrust. Precision limit switches and the extremely fast reaction of the "Hi-Cyclic" valves provide reliable depth control. Two general sizes of units are available; however, each installation is tailored to the particular drill press to be automated and to the work to be accomplished.

Circle Item 579 on inquiry card

Hughes Numerical Machine Tool Control

A completely transistorized, two-axis, numerical machine tool control which provides discrete positioning of work for turning, drilling, punching, riveting, or spot-welding operations was placed on display recently by the Industrial Systems Division, Hughes Aircraft Co., Los Angeles, Calif. This compact control unit shown in Fig. 1 is immediately available for use on new machines or for application to older units. Developed to produce significant savings in tooling and machining time, it features highly advanced diode and transistor circuitry, designed in modular units for easy maintenance and reliability.

The digital control utilizes mercury-wetted relays to provide long life and high reliability, and has electronic-photocell position transducers. A single compact cabinet houses the photocell tape reader, operator control, and electronic circuitry (see Fig. 2). The unique Hughes creep-traverse drive unit is said to assure accurate high-speed positioning at 180 inches per minute.

To operate the numerical-control unit, machining instructions are placed on punched tape by means of a Hughes tape-preparation unit. (Other standard tape-preparation units may also be used to prepare the taped instructions.) The tape



Fig. 1. (Left) Precision drilling machine equipped with numerical control introduced by the Hughes Aircraft Co.

Fig. 2. (Right) Interior of Hughes numerical-control unit shown in Fig. 1

is then inserted into the control unit, where information is automatically read by the photocell tape reader, and relayed to the machine tool. While the machine tool is performing one operation, the tape unit is reading the next instructions, thus speeding up the machining process.

Repeatable accuracy is held to 0.0002 inch or better. The control unit is designed to perform automatically such machining jobs as drilling, boring, turning, riveting, spot welding, punching, and eye-

let inserting. To allow for initial checkout of machining runs, the control can be set for manual and semi-automatic, as well as fully automatic, operation. Because of the low power requirements of the transistorized circuitry, total power requirements for the Hughes control unit have been greatly reduced. The control plus drive motors requires less than 7 amperes. A third-axis feed control can be added to the unit, if desired.

Circle Item 580 on inquiry card

Precision Grinding Attachment for Boring Mills and Vertical Turret Lathes

An existing boring mill or vertical turret lathe can be instantly converted from metal turning to grinding by the installation of a grinding attachment brought out by Standard Electrical Tool Co., Cincinnati, Ohio. With this equipment only one setup of the work is involved. After the metal turning is accomplished, identical register for grinding is obtained by allowing the work to remain in place. The grinding operation is

then performed by removing the metal-turning tool and installing the grinding attachment.

The illustration shows the Standard super-precision grinder attachment designed for internal or external grinding mounted on the swivel slide of a vertical type turret lathe. This is accomplished by removing the turret and stud, drilling and tapping four holes in the taper face of the vertical slide to bring the grinding spindle di-

rectly on the center line with the table. This is only one of nine individual designs of grinding attachments which may be applied to a vertical turret lathe. Other grinder conversions for boring mills are also available.

Circle Item 581 on inquiry card

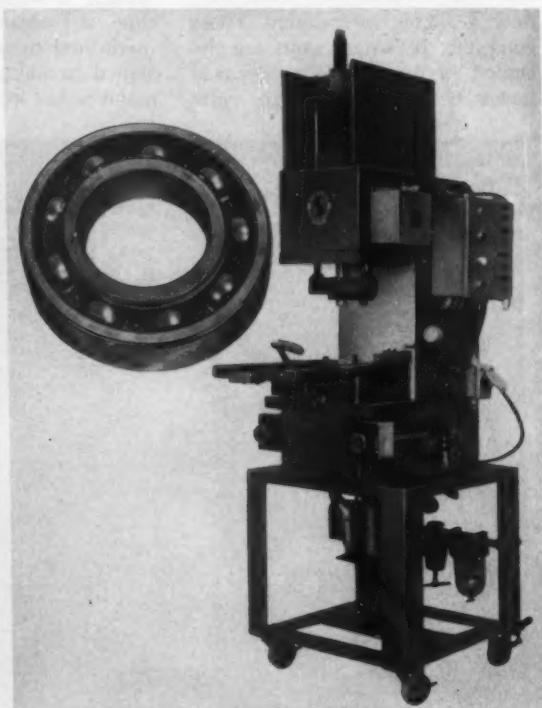
Presses Tooled for Use in Semi-Automated Production Line

Ten presses built by the Studebaker Hydraulic Products Co., Melrose Park, Ill., for use on a semi-automated production line, have been installed in one of the country's largest bearing plants. These 10-ton model presses are being used to stake retainers in roller bearings. Operational reports have already shown greatly increased output due to controlled pressure at high production speeds with minimum rejects.

The presses are capable of ram cycle speeds up to 2500 per hour. They are equipped with two-hand safety controls, wired for either momentary contact through timer control for positive stroke cycle,



Vertical turret lathe equipped with grinding attachment brought out by the Standard Electrical Tool Co.



One of ten Studebaker presses built for installation in semi-automated production line

or manual control. The 1/2-inch power stroke is controlled by Microswitch. Positive mechanical down-stop control of the ram operates independently of oil or electrical circuits, and is adjustable to close tolerances. Daylight between ram and bottom plate is 16 inches, throat depth is 8 inches, and ram stroke 8 inches.

The press, as shipped from the factory, is complete with all necessary valves and electrical controls ready for installation and tooling. Standard models in 1 1/2-, 2 1/2-, 5-, and 10-ton capacities operate on compressed-air supply systems at a pressure of 80 psi. Operating control circuits are either 100 per cent compressed air or electrical.

Circle Item 582 on inquiry card

Micro Hardness Tester

A "Kentron" micro hardness tester with a vertical capacity of 8 inches has been announced by the Torsion Balance Co., Clifton, N. J. This tester applies dead-weight

loads from 1 to 1000 grams. (Additional weights for applying heavier loads up to 10,000 grams can be furnished as optional equipment.) Known as the Model AK 8, this equipment is basically a production-control design but has the same accuracy as the manufacturer's Model AK tester which is a standard research instrument used in metallurgical laboratories.

The hardness tester is specially designed to test unmounted parts and mounted specimens, small parts, sheet metal, wire, etc.

Circle Item 583 on inquiry card

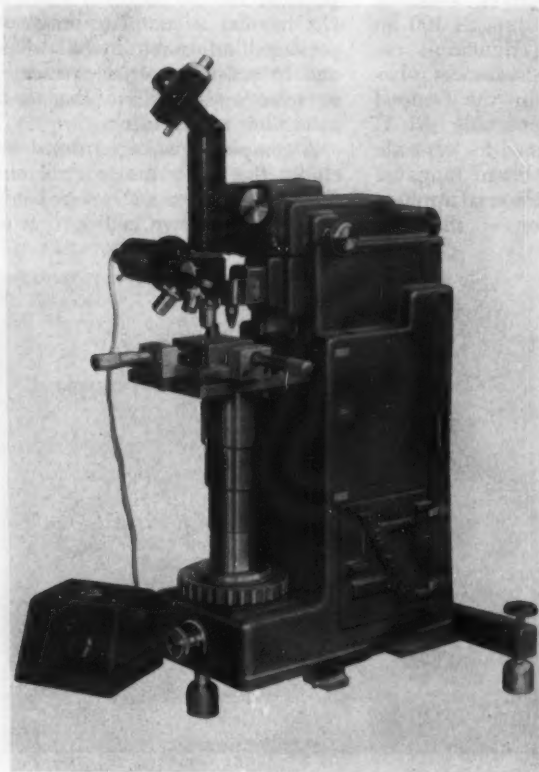
"Revlac TriGrinder"

A three-way, high-accuracy "Revlac TriGrinder" designed for internal and external cylindrical and surface grinding is being introduced in the United States by Russell, Holbrook and Henderson, Inc., New York City. This is a small grinding machine of exceptional accuracy that can be quickly changed over from one type of grinding to another.

To change from chucking or faceplate work to grinding work on centers it is necessary only to swing the work-head around through an angle of 180 degrees. To change to internal grinding merely involves the mounting of the proper quill. The change to surface grinding requires only the swiveling of the wheel-head through 90 degrees and mounting the appropriate magnetic chuck or holding fixture.

Speeds of both work-head and grinding head are infinitely variable throughout their range by means of rheostats, employing whatever input current is available. The conversion unit for changing alternating to direct current is located in the machine. Both spindles have a visual, nonmechanical indicating dial showing the exact speed of each. The grinding spindle has a speed capacity in excess of 40,000 rpm. Bearings are self-adjusting and allow for thermal diametral and linear expansion.

Down feed for surface grinding has both coarse and fine settings.



Torsion Balance Co.'s "Kentron" hardness tester

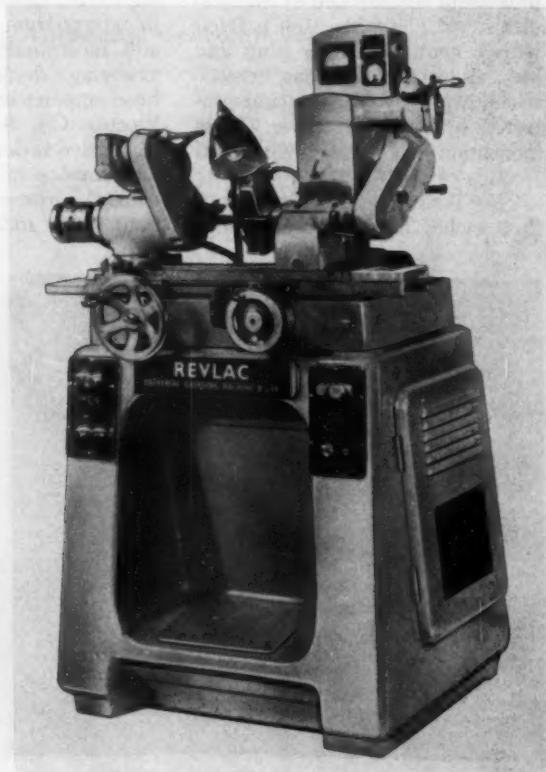


Fig. 1. "Revlac TriGrinder" setup for grinding on centers

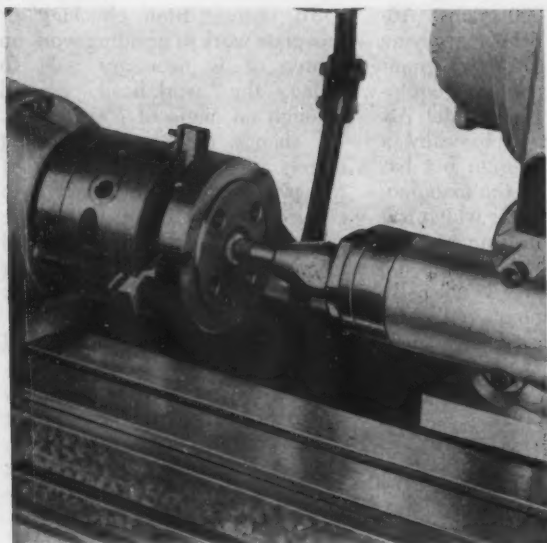


Fig. 2. Internal grinding setup on machine shown in Fig. 1

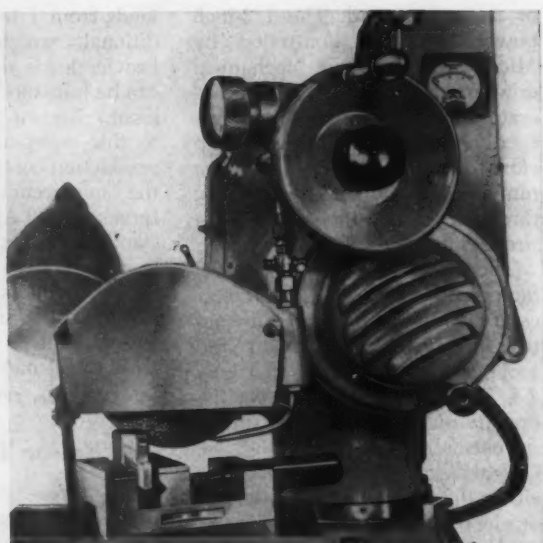


Fig. 3. Setup for surface grinding on the "Revlac TriGrinder"

The fine setting is in increments of 0.0001 inch. Cross-feed of table movement is similarly equipped, the fine feed being calibrated to 0.00005 inch per division. Finishes as fine as 1 micro-inch are attainable with suitable attention. Table movement is controlled by micrometer stops. The table itself is fitted with a central locating plug and has an angle-indicating device which is plainly readable and protected by a hinged cover. Table inclination can be set within 15 seconds of arc.

The TriGrinder takes work up to 9 inches between centers and

has a table travel of 12 inches. Table feed is by handwheel through compound gearing. All

electrical components are readily obtainable in this country.

Circle Item 584 on inquiry card

G-E "Kinatrol" Adjustable-Speed Drives

A line of eddy-current coupling, adjustable-speed drives, available in ratings from 5 through 100 hp and incorporating significant engineering design advances, has been announced by the General Electric Co., Schenectady, N. Y. This drive is designed for versatile performance in a broad range of general-purpose industrial applications. The addition of the new

"Kinatrol" line is said to make it possible for the General Electric Co. to offer a complete range of packaged adjustable-speed drives and to assist industrial customers in selecting the drive that best suits their requirements.

A complete, packaged drive includes the drive unit, control enclosure, and operator's control station such as shown in Fig. 1. It is

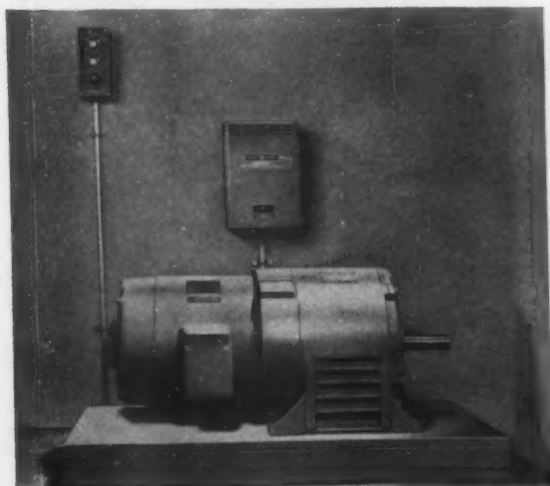


Fig. 1. Kinatrol adjustable-speed drive announced by the General Electric Co.

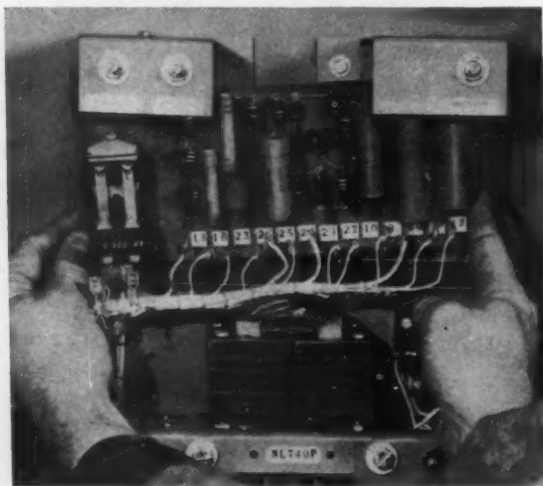


Fig. 2. Plug-in component board of exciter-regulator of G-E Kinatrol drive

claimed that optimum performance and easier installation and start-up can be expected from the Kinatrol line because the drive is designed, manufactured, and tested as a package. The drive offers versatile performance over a constant-torque speed range. Drives with ratings through 20 hp are capable of continuous operation down to 100 rpm at rated torque, providing a speed range of approximately 17 to 1.

Automatic control provides close speed regulation as standard. On a typical friction type load, for example, regulation of 2 per cent of full speed can be obtained with standard equipment.

A variety of drive and control features can be added to the basic drive for better protection, reversing, braking, and special control functions.

The Tri-Clad 55 alternating-current motor and eddy-current coupling, adjustable-speed member shown in the cutaway view, Fig. 3, are integrally designed to provide an unusually compact drive unit. Since it is designed for low maintenance costs, there are no rotating windings, brushes, or slip rings. The stationary-field coil and tachometer-generator coil are completely encapsulated in epoxy resin for positive protection. Advanced six-bearing design serves to reduce main-bearing loading and assure positive gap alignment for trouble-free operation and easy re-assembly. Generous grease reservoirs are provided adjacent to the inner-bearing shield to provide continuous controlled lubrication for years of service without attention.

The integral alternating-current flux switch tachometer generator is of novel two-coil high-frequency design developed for greater simplicity and higher voltages. This serves to eliminate the need for voltage amplification. Windings and magnets are in the stator, encapsulated for positive protection from electrical failure, mechanical abuse, or magnetic knockdown. This construction is said to virtually eliminate maintenance costs.

Efficient coupling ventilation makes possible the small physical size and wide speed range of the drive units. Air flow purges foreign matter from the coupling with air

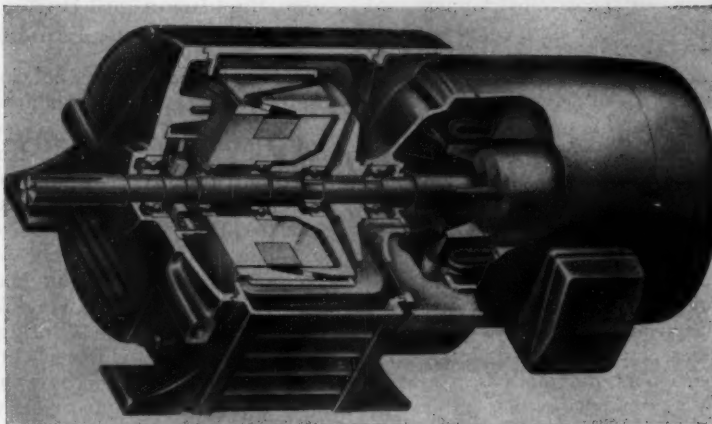


Fig. 3. Cutaway of Kinatrol eddy-current coupling integrated-drive unit

paths designed to keep the noise level and external-air disturbance at a minimum.

The control enclosure for packaged drive includes exciter-regulator (electronic or amplistat) for coupling control, and may also include alternating-current motor-starter and short-circuit protection. Wiring is front-of-board type for

easy accessibility and enclosure mounting versatility.

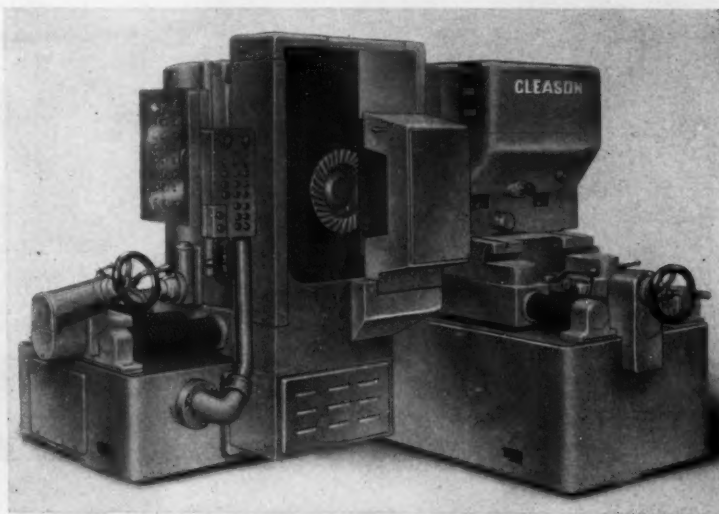
All small resistors, capacitors, and rectifier diodes in the exciter-regulator are mounted on a plug-in component board, as seen in Fig. 2. This board is replaceable in minutes, and the replaced board can then be repaired by the user.

Circle Item 585 on inquiry card

Gleason Automatic Gear-Lapping Machine

An automatic lapping machine for lapping large spiral bevel and hypoid gears up to 36 inches in diameter is announced by the Gleason Works, Rochester, N. Y. Any shaft angle from 10 to 130

degrees can be handled. While lapping compound is pumped on a pair of gears, the relative position of gear and pinion is changed continually and automatically to lap the entire surfaces of the teeth.



Automatic lapping machine for large spiral bevel and hypoid gears announced by the Gleason Works

New servo-controlled lapping motions and variable spindle speeds from 200 to 2000 rpm allow complete flexibility and extended control of tooth contact area.

A swinging motion of the pinion head sweeps the bearing area along the length of the tooth. A lateral motion of the gear head moves the bearing area up and down the tooth profile, while a lateral pinion-head motion maintains uniform backlash. With servo-mechanisms controlling these motions, the lapping time for any portion of the tooth is regulated by a simple dial setting.

Machine features include an automatic backlash mechanism which maintains the same lash from pair to pair, regardless of dimensional differences in the gears. All gears are lapped with the lash they will have in final assembly, without attention from the operator.

The operation is entirely automatic. Push-buttons control withdrawal of the pinion head for chucking, the advance of the work to the operating position, closing of the lapping guards, and starting of the lapping cycle.

Circle Item 586 on inquiry card

Parkinson and Butler Machine Tools Introduced by Lapointe Machine Co.

The Lapointe Machine Tool Co., Hudson, Mass., has announced that five lines of British machine tools will be sold and serviced in this country by its newly formed subsidiary firm, the Lapointe Machine Co., Hudson, Mass. The five British lines include a full range of precision surface and internal grinders made by the Churchill Machine Tool Co.; large surfacing, boring, profiling, and screw-cutting lathes manufactured by John Lang & Sons, Ltd.; large-capacity ram type and combination turret lathes built by H. W. Ward & Co., Ltd.; milling machines and gear planers, including the "Gearbur" for deburring spur and helical gears made by J. Parkinson & Son, Ltd.; and planers, shapers, and slotters produced by the Butler Machine Tool Co., Ltd.

These five companies have for many years marketed their products throughout the world through a jointly owned and operated sales subsidiary, the Associated British Machine Tool Makers, Ltd. Up to the present time, however, this sales organization has not been

active in the U. S. market. Now, the Lapointe Machine Tool Co., through formation of its new subsidiary sales and service organization, will market the five British lines here with the full sales and service resources of the parent company and those of Lapointe. The machines will carry the nameplates: "Lapointe Churchill," "Lapointe Lang," "Lapointe Ward," "Lapointe Parkson," or "Lapointe Butler." Each nameplate will also carry the address of the Lapointe Machine Co. Two of the machines to be included in this line are the Lapointe Parkson No. 2 NU universal miller (Fig. 1) and the Lapointe Butler No. 9 planer illustrated in Fig. 2.

Machines of all five lines will be set up at Lapointe headquarters in Hudson, Mass., for production, demonstration, and instruction. Replacement parts will be stocked by Lapointe at Hudson, Mass. Blueprints for prompt production of machine parts which are not stocked in this country will also be kept on hand.

Circle Item 587 on inquiry card

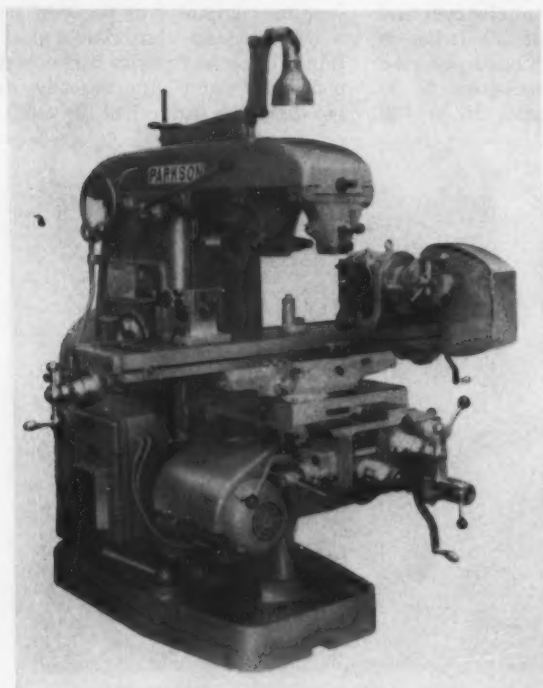


Fig. 1. Lapointe Parkson universal milling machine

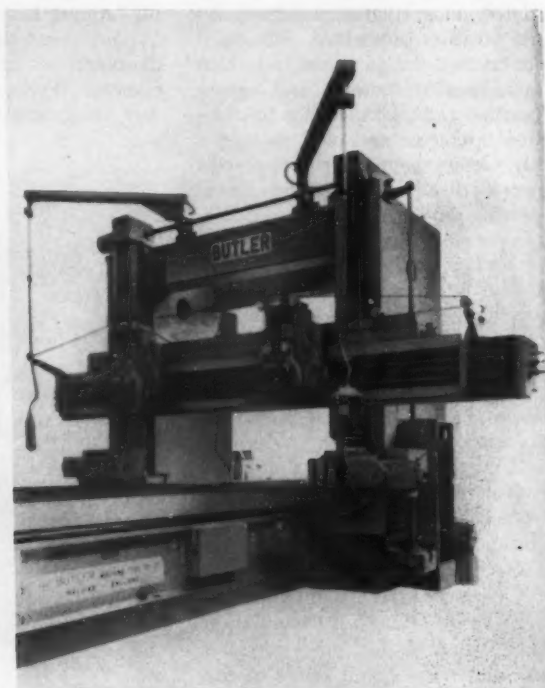


Fig. 2. Lapointe Butler spiral electric planer

Bullard Vertical Turret Lathe Design Eliminates Handwheels

Two "multi-directional" levers control all traverse and feed movements of "Dynatrol" vertical turret lathes being introduced by the Bullard Co., Bridgeport, Conn. The machines, available in table diameters from 26 to 124 inches, have a unique look in that all handwheels are dispensed with. A 36-inch machine appears in Fig. 1.

In Fig. 2 is a close-up view of the machine's control area, with the operator's hand gripping the upper of the two levers. Each lever produces a traverse motion when it is pivoted laterally to the left. The rate of traverse—from 0 to 9 feet per minute—is varied according to the distance the lever is pivoted from neutral. When the turret or side-head has been traversed close to the work, the feed is engaged by pivoting the lever all the way to the right. The upper lever controls the left and right movement of the turret carriage on the cross-rail and the up and down movement of the turret-slide. The lower lever controls the left and right movement of the side-head slide and the up and down movement of the side-head carriage.

To select the direction of slide or carriage movement, the levers are turned axially by a twisting motion of their pistol-grip handles. As can be seen in Fig. 2, the operator has the upper-lever handle pointing up, so that lateral pivoting of the lever produces an upward traverse or feed of the turret slide. (Twisting the lever 180 degrees sets up a downward slide movement; twisting it 90 degrees counterclockwise or clockwise sets up a left or right movement of the turret carriage. In the same manner, twisting the lower lever sets up the desired direction of traverse or feed of the side-head.)

Large, easy-to-read clock type dials with dual pointers register the movements of the sliding ele-

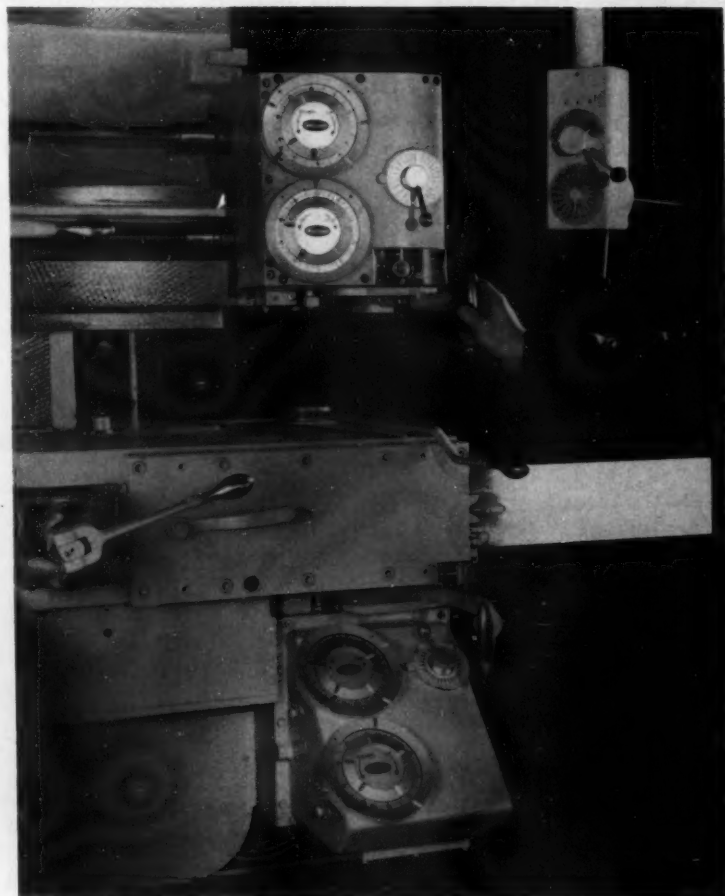
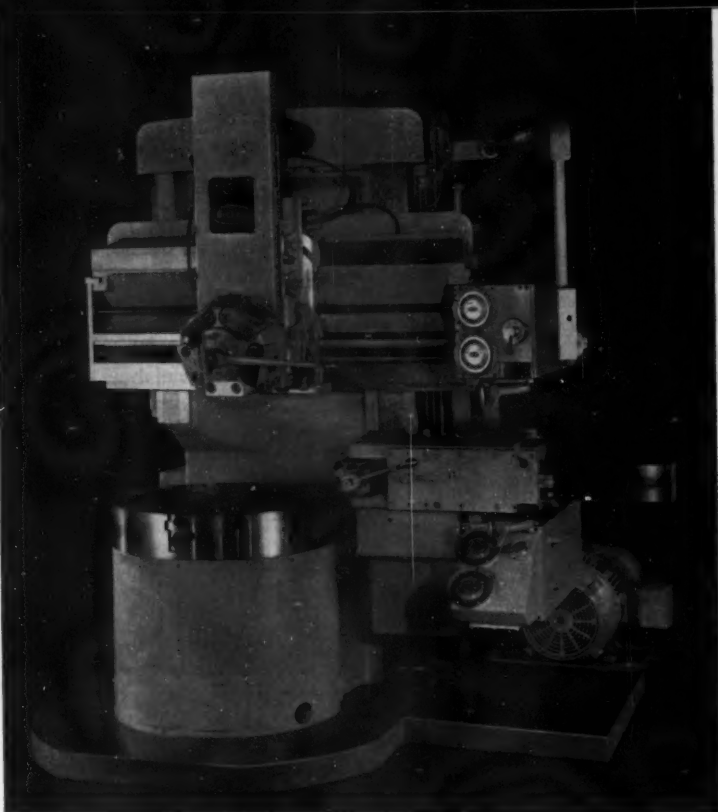


Fig. 1. (Above) Bullard "Dynatrol" vertical turret lathe

Fig. 2. (Right) "Handwheel-less" operating area of 36-inch Bullard

ments. Graduations and numerals remain stationary while the pointers rotate, one registering tenths of an inch and the other, thousandths of an inch. In positioning a tool to the work, the operator watches the pointers rather than the tool itself. He traverses it rapidly at first, then slows and stops it as the pointers reach the proper reading on the dial.

Feed rate is infinitely variable and is indicated on a direct-reading dial. It can be changed at any time during the cut, without stopping the table. A pendant seen on the right of the machine contains a table speed-selector dial and a

clutch lever for starting, braking, and stopping the table.

Remote control of the turret lathe is provided by a portable accessory that can be held in the palm of the hand. It has a push-button for starting or stopping the table, four more buttons for selecting the direction of traverse, and a traverse and feed engagement lever. Other available accessories include a Size-Au-Trol head positioner; contouring attachments; power-indexing turrets; thread-cutting, drum-scoring, and angle-turning attachments; and power-operated chucks.

Circle Item 588 on inquiry card

Abrasive Cutting Machine

A versatile, large-capacity, dry-abrasive type cutting machine, designated the Model 2-A Sever-All, has been introduced to the trade by the Allison-Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. This is a low-cost unit designed for heavy-duty work in metalworking plants, steel mills, factories, warehouses, maintenance shops, etc. It has the capacity to cut practically all metals including cold- and hot-rolled steel, alloy and carbon

steel, stainless steel, cast iron, and nonferrous metals up to 4-inch round or square solid bars; 5 1/2-inch outside diameter pipe or tubing; 6- by 1-inch flat stock; 6-inch angle iron; and 8-inch channels.

The work is manually fed to this oscillating type abrasive cutting machine. The power-driven wheel oscillation enables the unit to sever large cross-sections of material with a fine quality of cut. In addition, oscillation reduces the arc of contact between the wheel

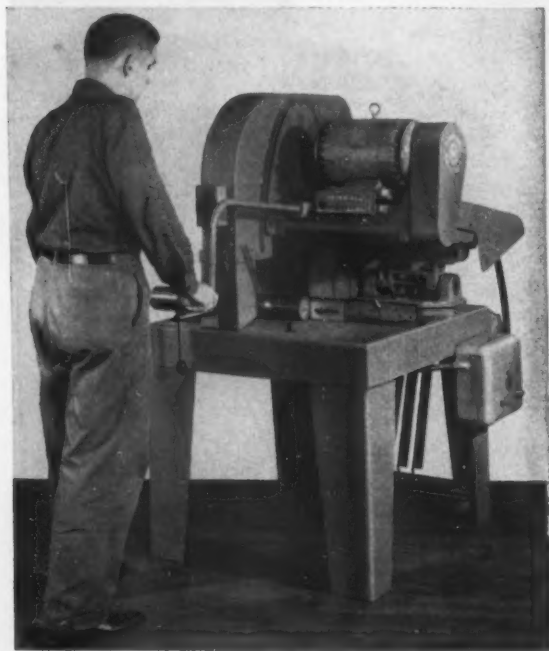
and the work, provides faster cutting action, reduces operator fatigue, and greatly increases wheel life. Cutting pressure is applied by the operator through a hand-operated lever located to the right of the abrasive wheel. The machine is equipped with a dual-voltage, 10-hp, special high-torque motor, and utilizes a 20- by 1/8- by 1-inch Sever-All abrasive cutting wheel. The cutting rate is from two to three seconds per square inch of metal cut.

Circle Item 589 on inquiry card

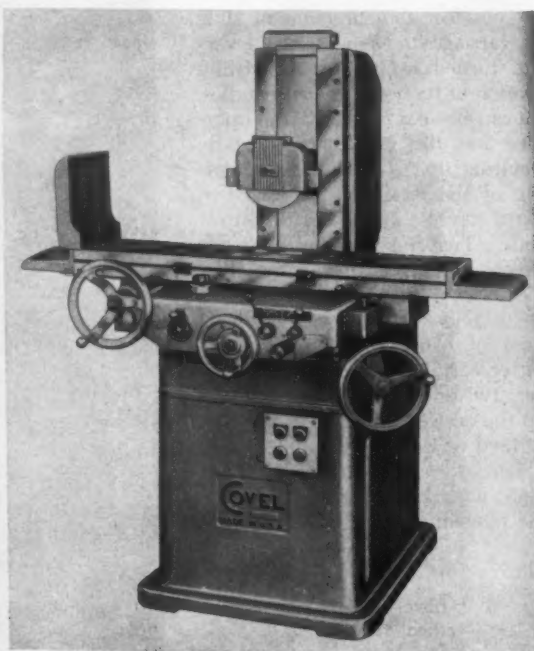
Covel Surface Grinder

The Covel Mfg. Co., Benton Harbor, Mich., has recently added a No. 10H 6-by 18-inch machine to its line of precision surface grinders. Outstanding features of this new hydraulic model are: 16 1/2-inch capacity from full 7-inch diameter wheel to top of table, infinitely variable cross-feed range from 0.005 to 0.250 inch with rapid traverse for dressing the wheel from the chuck or quick positioning the work, power elevation for rapid positioning of the grinding wheels, and inverted vee crossways.

Circle Item 590 on inquiry card



Sever-All large-capacity dry-abrasive cutting machine



Hydraulic surface grinder announced by Covel Mfg. Co.

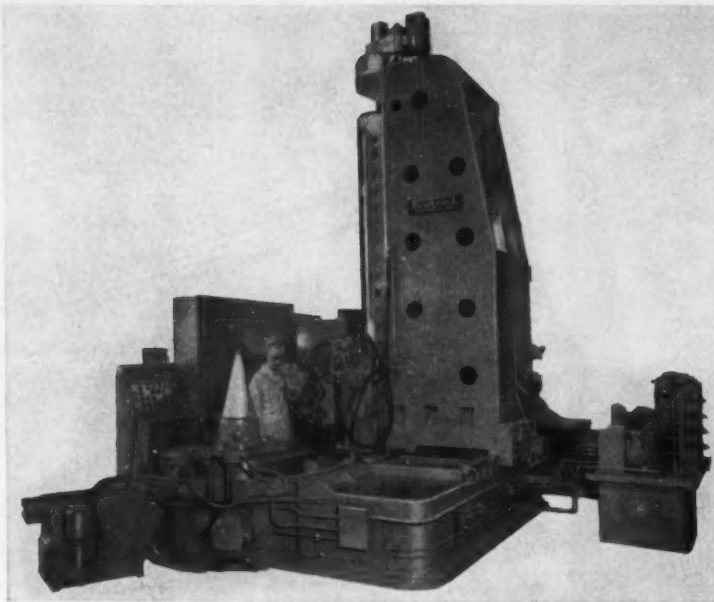


Fig. 1. Barnesdril numerically controlled drilling machine with vertical travel, two-spindle combination drilling and tapping head

Four-Motion Barnesdril Programming Machine

A numerically controlled drilling machine capable of programming four motions, two more than earlier models, has been announced by the Barnes Drill Co., Rockford, Ill. The horizontal, two-spindle drilling machine can drill and tap cylindrical sections with maximum diameters of 36 inches and a maximum height of 72 inches. This machine can also handle conical and ogive-shaped sections. The horizontal drilling unit employs vertical-spindle movement with air counterbalance, in-and-out column travel movement of 24 inches, and a rotary table 40 inches in diameter for positioning the work. It will perform combination drilling and countersinking, combination drilling and counterboring, straight drilling, reaming, counterboring, countersinking, and tapping operations. Holes can be spaced equally or unequally to an accuracy of plus or minus 0.003 inch for true position, and repeatable accuracy of plus or minus 0.0005 inch.

The rotary table, which is

powered by a 3/4-hp motor, can be indexed through 360 degrees from the given reference point at a speed of 1.25 rpm. The table has a lifting mechanism to facilitate

rotation and a clamping arrangement for locking it when the desired position is reached. Since all rotary positioning is accomplished from a common reference point (zero position of the table) the possibility of accumulative errors is eliminated.

The numerical-positioning control is operated from information punched in standard 8-channel Flex-O-Writer tape. All positioning movements, including the in-and-out travel of the column and the vertical movement of the spindle, are coded in decimal form from a common reference point to insure accurate positioning over the entire length of travel.

The controls on the machine also perform the auxiliary functions of supplying instructions for the machine and for the operator. Instruction lights on the control panel automatically indicate when tool changes are required for the different operations being performed. The machine will not function unless the proper tool is in the spindle and all other tools are correctly located in the six-position tool board. Automatic machine instructions include coolant selection, on-off, rapid ap-

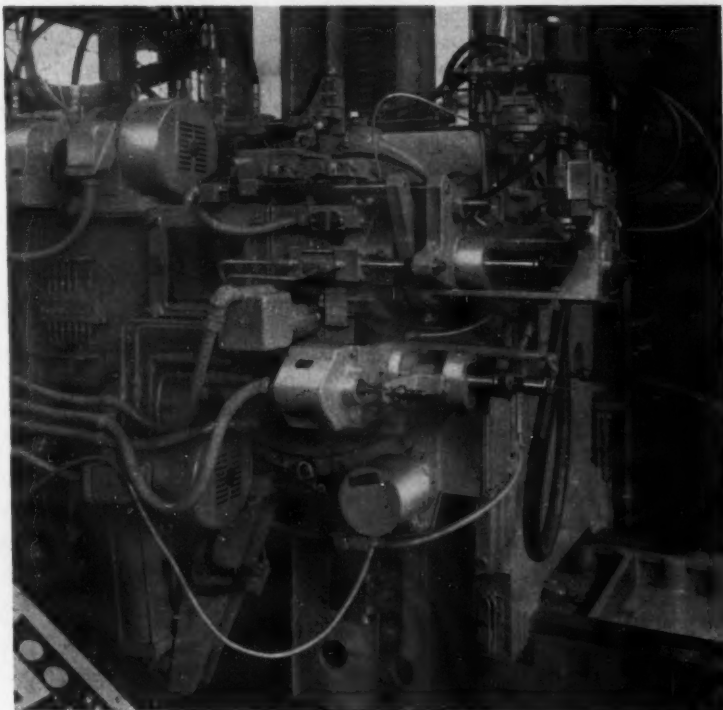
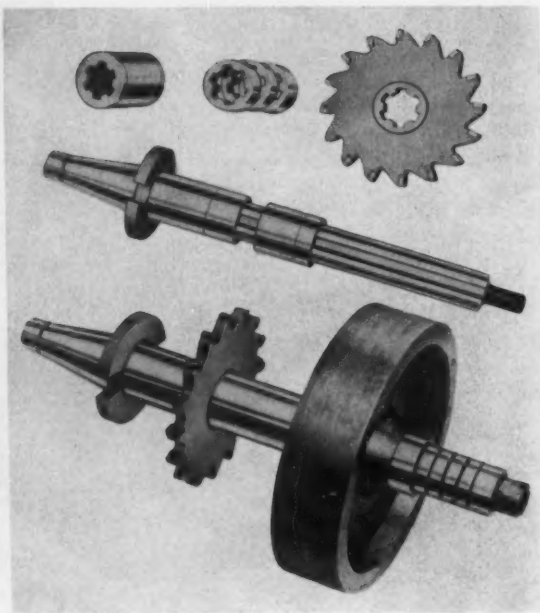


Fig. 2. Close-up of Barnesdril numerically controlled machine (Fig. 1)



Dial indicator checking kit called the "Checkit" made by "Go-Devil" Instrument Co.



Pratt & Whitney splined milling arbors for machining high-strength alloy steels

proach, and sensing. A special device senses the depth of the tool from the face of the work.

In order to assure complete flexibility of the controls for the manufacture of different parts, all positioning motions of the machine units, as well as instruction of operator and control of the machine, are accomplished simultaneously from the information punched on the tape. When all conditions set up on the tape have been satisfied, the control supplies a signal which starts the machine function after the rotary position has been automatically checked. When all holes in one row have been completed, the tape positions the spindle vertically, rotates the table, and moves the column into position for processing the next row of holes. An automatic lubricating system is provided for the antifriction ways and a spray-mist lubrication for the head.

Circle Item 591 on inquiry card

Kit for Checking Dial Indicators

A "Checkit," comprising a master micrometer head and three adapters for coupling it to regular, test type, or long-range indicators

for checking the accuracy of dial indicators, is being manufactured by the "Go-Devil" Instrument Co., Poughkeepsie, N. Y. This kit can be used to check more than 300 difference makes, models, and sizes of indicators, including tool-maker's test types. It will check indicators having 0.0001-, 0.00025-, 0.0005-, and 0.001-inch graduations. With this kit, defective and sluggish indicators can be detected before they cause spoiled work.

Circle Item 592 on inquiry card

Splined Milling Arbors

A radical improvement in heavy-duty milling performance, particularly in the machining of modern, high-strength alloys in the hardened state, is claimed for the splined milling arbors and cutters recently introduced by the Pratt & Whitney Co., Inc., West Hartford, Conn. Metal-removal rates are said to be increased by 92 to 400 per cent with cutter life lengthened proportionately when these arbors are used. For example, in actual milling operations on 5415 steel, with Brinell hardness of 255 to 260, stock was removed at the rate of 50 cubic inches per minute.

In this new construction, both the arbors and the spacers used with them are splined. As a result, very fast cutting is possible, and the chatter that causes carbide tips to shatter is virtually eliminated.

The milling cutters used with these arbors are also splined and precisely positioned on the accurately ground inside diameter of the splines so that they are driven by the sides of all six splines. As a result, the take-up nut need only be brought up to "hand tight" with a wrench, no extra leverage or hammering being required.

This new line includes splined milling arbors, cutters, spacers, and flywheels. Both the splined cutters and arbors can be used interchangeably with conventional plain types of the same size. Splined milling arbors, with 50 MM taper, are made in 1-, 1 1/4-, 1 1/2-, and 2-inch diameters in standard lengths. Other lengths can be furnished on application. Each splined arbor is equipped with a splined antifriction bearing which can be positioned anywhere on the arbor's length. Two or more bearings can be used where extra rigidity is desired.


Circle Item 593 on inquiry card
(This section continued on page 177)



boring



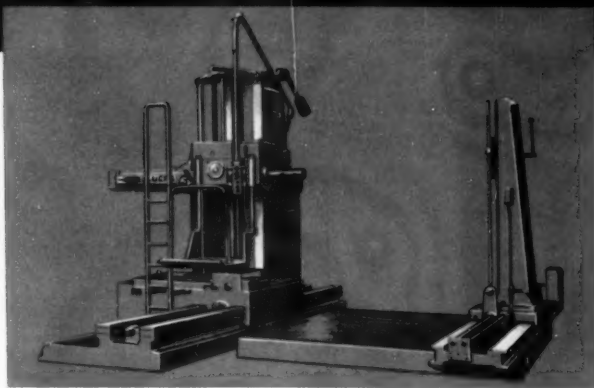
drilling



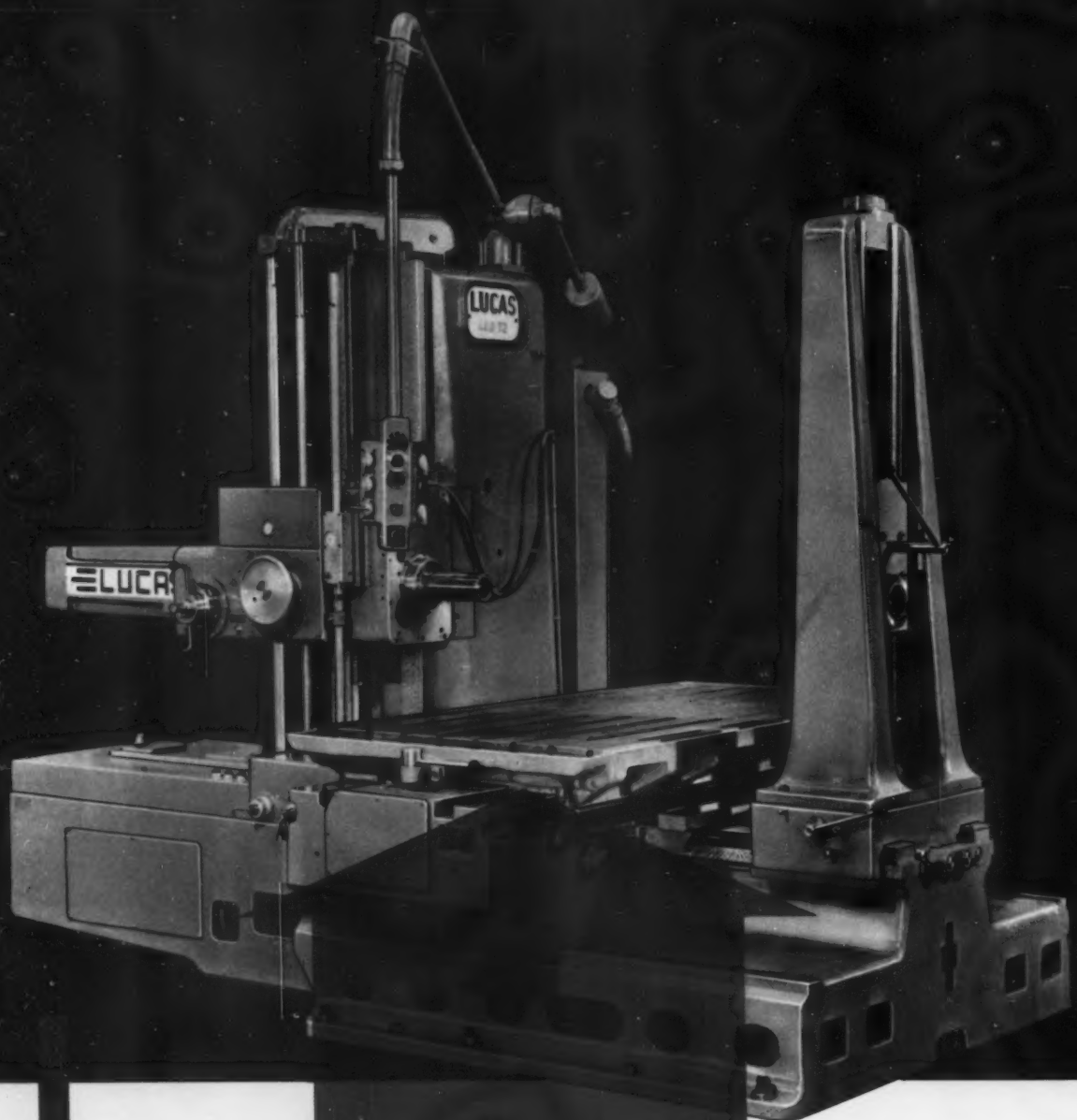
milling

Floor type machines **YES!**

A complete line of floor-type, horizontal boring, drilling and milling machines in the 4" and 5" spindle diameter range... with all the features and controls available in other Lucas models. Many of these are to be found *only* in a Lucas. *Did you ever meet a man who regretted picking a Lucas?*



LUCAS
OF CLEVELAND



AIR LIFT*

to saddle and table

All Lucas components are fitted with the utmost precision. To insure lifetime accuracy, the saddle and table ride on lubricated compressed air... *ever so slightly above the surface of the ways.* Traverses, either feed or rapid, are silk-smooth and free of wear.

*Patent Pending

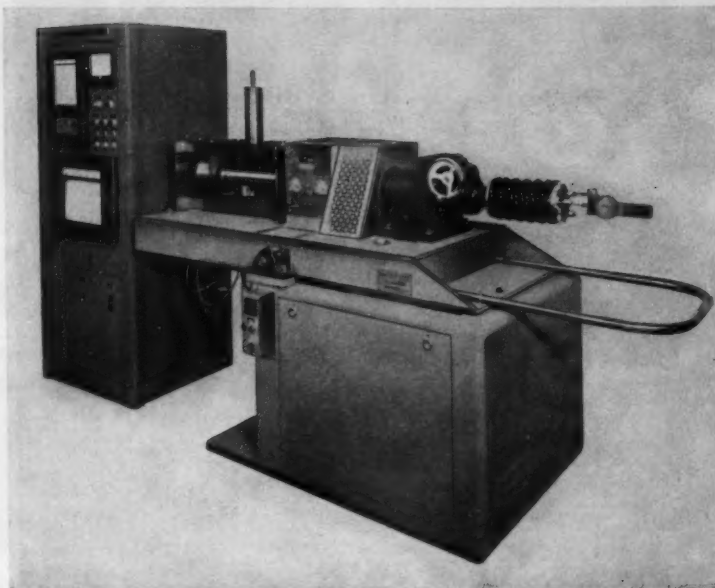


LUCAS
OF CLEVELAND

Versatile Lubricant-Testing Machine

A lubricant-testing machine designed for environmental research has been announced by the Alpha-Molykote Corporation, Stamford, Conn. Known as the Model LFW-3, it can be adapted to testing either dry or liquid lubricants, at ambient to high temperatures, with oscillatory or rotational motion, over a wide range of velocities and loads. A high-temperature furnace is supplied as standard equipment. However, sufficient space has been provided in the specimen area for the future installation of a variety of environmental chambers such as one for low-temperature testing. A 5-hp motor allows the machine to operate at friction coefficients of 0.5 at full load.

The testing machine is furnished complete and ready to operate with all electrical equipment necessary to give full protection against overload and low voltage. Instrumentation is mounted in a



Machine for testing lubricants announced by Alpha-Molykote Corporation

separate cabinet wired for easy connection to or disconnection from the testing machine.

Circle Item 594 on inquiry card

"Rotary Broach" for Resurfacing Cylinder Heads

A fully automatic "Rotary Broach" that resurfaces cylinder heads, engine blocks, and similar work in three quick, easy steps has been introduced by the Van Norman Machine Co., a division of Van Norman Industries, Inc., Springfield, Mass. Resurfacing an average cylinder head to the exact precision micro-inch surface required for a perfect gasket seal is said to be accomplished in less than ten minutes on this Model 570 "Rotary Broach." Three simple steps give maximum operating speed. Work is set up on the loading table, the micrometer up-feed control set for required positive stock removal, and the automatic traverse feed started. The machine stops automatically at the end of the traverse.

A built-in loading table permits fast, top-side setups directly from machined surface of work. Exact level-line positioning assures accuracy. A special new cutter provides individual, easily replaced, carbide inserts which can be sharpened with a special-cutter lapping

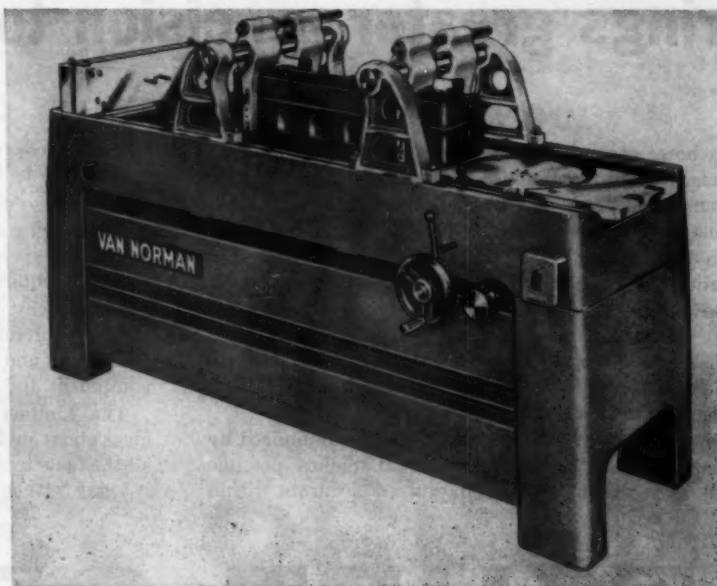
fixture, eliminating the need for factory sharpening service.

A Van Norman micrometer gage allows the operator to quickly set

inserts to uniform height and concentricity. Two sets of holding fixtures securely hold a variety of work including V-8 engine blocks and overhead valve type cylinder heads, also in-line engine blocks and cylinder heads. All controls are grouped together in a single unit for maximum operator convenience.

Circle Item 595 on inquiry card

(This section continued on page 180)



Van Norman automatic "Rotary Broach"



Lindner LB14 Jig Borer at Philips Electronics, Inc., Mount Vernon, N. Y., has 32" x 16" table. Also available in larger model, LB15A with Autopositioner®—Table 44" x 24".



Precision Production—Boring 20 holes in the specimen plate cover of the Norelco Model 100KV Spectrograph. Done in one set-up. Time: 2 hours. 30% faster than previous methods!



Precision Tooling—Boring holes in a drill jig for the Norelco Powder Camera. Opposite holes must be aligned within .0001".

How the Lindner Optical Measuring System brings greater precision to jig boring

at Philips Electronics, Inc.

A jig borer can be no more accurate than its measuring system. And in the Lindner the problem of maintaining *permanent* accuracy has been solved by the machine's unique *fully optical* measuring system.

No lead screws. No gage blocks. No bars or limit switches. The helically scribed, cylindrical measuring scales in every Lindner are touched by a light beam only. These scales are independent of the table movement mechanism and *immovable* in axial direction. Thus, the whole system is permanently protected against any mechanical wear whatsoever. Lifetime accuracy!

Visual fatigue and errors in settings are minimized by a photo-electric centering device. It makes possible initial and repeat settings guaranteed accurate within

.00015" over the full length of travel and readings in .00005".

There's no eye strain or bending. A helical line from the measuring scale is projected onto a 2½" wide screen which the operator reads from a standing position. No eyepiece required.

That's why Philips Electronics—like so many other precision producers—relies on the Lindner for tooling, production and inspection of its Norelco atom measuring equipment and other precision research tools.

The Lindner optical measuring system is changing ideas about jig boring all over the country. We've packed all the facts into a meaty 25-minute movie film. Send for it today without obligation. Or write for literature.



KURT ORBAN

COMPANY, INC.

42 Exchange Place, Jersey City 2, New Jersey

"With the S & F gear tester
we make sure our gears
are as accurate as
specifications demand"

says Philips Electronics, Inc.



Section of Graphotest record checking out 10" pitch diameter gear on S & F Model 110 Gear Tester at Philips Electronics.

there's no gear tester as accurate as the S & F—
GUARANTEED TO REPEAT WITHIN .00001"!

The engineer sets down his gear specs. The gear hobber goes to work. The gear tester checks out the finished gear. Perfect! *But is it?*

The plain fact is that the gear tester is all too often the weakest link in the chain. And until the S & F came along, manufacturers had no sure way of knowing their "precision" gears were as precise as they were supposed to be.

No such doubt exists at Philips Electronics. Shown above is a special spur gear used on the Norelco Goniometer. Its basic pitch diameter is 10", diametral pitch 36", number of teeth 360. Print specs call for a total

composite error on 360° rotation of .001" and the gear must be concentric within .0003", total indicator reading. Pretty close tolerances for a gear of this size.

Has Philips achieved it? They're never in doubt. "We are now able to verify the accuracy of our gears to an extent never before possible," say Philips engineers.

And this experience is typical of hundreds of precision-minded plants all over the country who are producing gears that *must* check out—and do—on S & F Testers.

We'd like nothing better than to show you how the S & F is revolutionizing gear checking. Or talk to any users near you. We'll send you their names.



KURT

ORBAN
COMPANY, INC.

42 Exchange Place, Jersey City 2, New Jersey

TransfeRobot for Secondary and Assembling Operations

A mechanical arm which swings in an arc and moves radially and vertically as well makes it practical to automate many secondary machining and assembling operations. The device, called a "TransfeRobot," has been developed by the Robodyne Division of U. S. Industries, Inc., Silver Spring, Md. Existing equipment such as parts feeders, punch presses, welders, and riveting machines can be utilized, it only being a matter of arranging such elements in a circle around the device.

At the end of the arm is a four-station turret which can be indexed at 90-degree intervals. Each station has an actuation post equipped with interchangeable pairs of fingers designed to grasp the work. The combination of the three coordinate movements of the arm—circular, radial, and vertical—can locate the turret to manipulate work anywhere within the active area of the TransfeRobot. This area is a band having an outside diameter of 36 inches, an inside diameter of 28 inches, and a height of 6 inches.

On the function panel of the equipment are timed electrical outlets through which it is connected to the machines it has to

operate. Timers can be set for any interval up to six seconds. This panel also contains a knob for setting circular and vertical speed of the arm, and a counter which stops production after a predetermined number of cycles.

A program panel consists of an array of two-way slide switches arranged in fifteen columns and forty-five rows. The rows correspond to the various motions and actions which the TransfeRobot has to perform to complete its cycle. The columns, in turn, permit the device to repeat each of its motions and actions up to fifteen times.

To "train" the TransfeRobot, the machines and accessories to be arranged around the arm are sketched in on a planning chart. Then, on a special form, the motion and action sequence is plotted against the time intervals. To

translate the sequence into the approximate pattern of switches to be thrown on the program panel, a stiff paper template is provided. The template provides a permanent record of the program and can be filed for re-use.

Five push-buttons on a setup panel control these modes: power off, power on, setup, single cycle, and run. Using the chart as a guide, the work positions of the arm are cranked in through knobs. As each work position is established, the equipment automatically "remembers" its three coordinates, and can return to the position within an accuracy of 1/8 inch.

Since this obviously is not sufficiently accurate, a scanner is built into the arm, which "homes in" on a small mirror at each work station. The scanner will home in over the center line of the mirrors to within 0.002 inch.

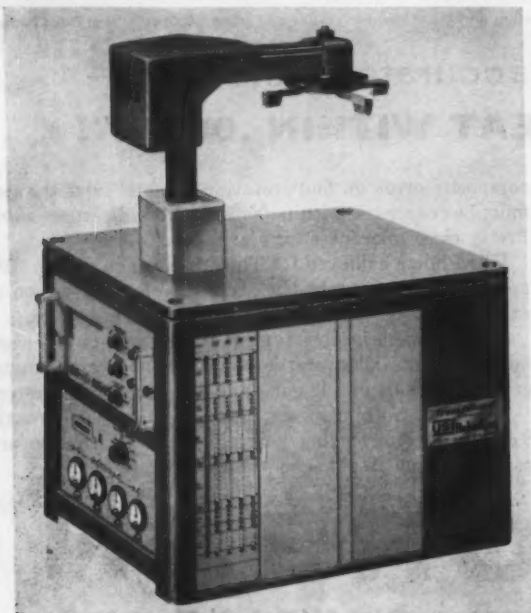
Circle Item 596 on inquiry card

High-Speed Magnetic Tape Transport

The life expectancy of magnetic tapes used with electronic data-processing systems is expected to be greatly increased by a high-speed transport unit announced by the Datamatic Division of Minneapolis-Honeywell Regulator Co.,

Minneapolis, Minn. This development was shown for the first time at the Ninth Eastern Joint Computer Conference and Exhibition held recently in Boston, Mass. The tape transport, first unit of the Honey-

(Continued on page 182)



Machine-operating and work-assembling TransfeRobot



Minneapolis-Honeywell high-speed magnetic tape drive

LOWEST COST

*per drilled
hole...*

Two vital factors in drilling costs are Machine Investment and Operator Time ... and CINCINNATI Customized Sliding Head Drills minimize both!

Your CINCINNATI is "tailored" to suit your type of work exactly. You buy only the cost-saving combination you need—minimum machine investment. You provide all the necessary time-saving equipment—the operator keeps the drill cutting more of the time.

And, these CINCINNATI Drills are *economy-priced!* The basic 24" machine with 6-speed vee-belt drive and hand feed—ideal for general purpose work—is only \$1090 ... only \$975 for the 16" model.

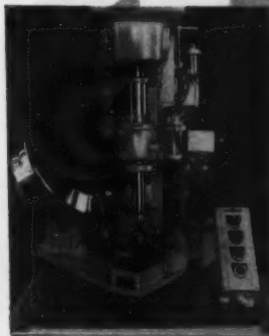
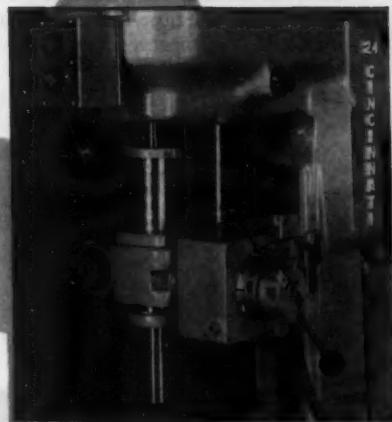
For toolroom work with many different hole diameters, the model shown at right above, has Infispeed variable speed drive and extra large work table.

If you do a lot of production drilling and tapping, you would want power feed with precision depth stop and feed disengage, and electrical tapping with automatic tap reversal, shown at right center.

Or, your CINCINNATI can provide a wide variety of economical automation, as in the fully automatic nut-tapping setup at lower right (only \$4,000).

These machines are built in medium duty 16" and 24" sizes with 1" capacity, heavy duty 21" and 25" sizes with 1½" capacity.

Ask your Cincinnati Lathe and Tool Dealer to recommend the exact machine for your jobs—or write to us direct.



CINCINNATI LATHE AND TOOL CO.

3207 Disney Street, Cincinnati 9, Ohio

"HYDRASHIFT" Lathes/"CINCINNATI" Drilling Machines/"SPIROPOINT" Drill Sharpeners



well 800 transistorized data-processing system to be publicly demonstrated, reads or records information at the rate of 96,000 decimal digits per second. Several of these units may be used simultaneously to supply or receive information at the tremendously high rate necessary to keep the central computer of the system busy.

A detailed demonstration of the functioning of Orthotronic control, an exclusive Honeywell system for automatically detecting and correcting errors in electronic data processing, was also given at the conference. The tape mechanism and Orthotronic control will be standard on the Honeywell 800 data-processing systems now being readied for commercial production at two Boston plants.

The Honeywell machine, using an all-vacuum drive (clutch) as well as vacuum to hold the tape reel on its hub and the tape on the reel, has been designed to provide the most gentle tape-handling unit possible. It is expected to virtually eliminate magnetic tape damage.

The tape is driven 120 ips (inches per second), in either direction, and is capable of reading or recording as many as 96,000 decimal digits (numerals) or 64,000 alphanumeric characters per second. It has a rewind speed of 360 ips.

The system has almost instantaneous response to start and stop

commands. It commences to move, on receipt of a command, in slightly less than 1 millisecond and in 2.7 milliseconds is traveling at full speed. The tape moves substantially less than 0.3 inches on deceleration before it comes to a complete stop.

The compactly built unit stands only 5 feet 9 inches high and occupies a floor area slightly over 2 square feet.

Circle Item 597 on inquiry card

Atrax Solid-Carbide Drills

"Micro-Drill" solid-carbide drills in wire gage sizes, numbers 61 through 80, with diameters ranging from 0.0135 to 0.0390 inch, are announced by the Atrax Co., Newington, Conn. The addition of this Series 1815 drills completes the Atrax line of drill sizes from No. 1 through No. 80. Solid carbide throughout, the Atrax "Micro-Drill" is precision-ground and has standard right-hand spiral flutes for right-hand cutting. It has a straight shank and a machine-ground point.

The 1815 Micro-Drills are especially recommended for drilling plastics, fiber, Fiberglas, carbon, and other nonferrous material. They are also ideally suited for precision drilling in electronic-circuit-board work. The drill diameter is kept to a tolerance of plus 0.0000 and minus 0.0005 inch.

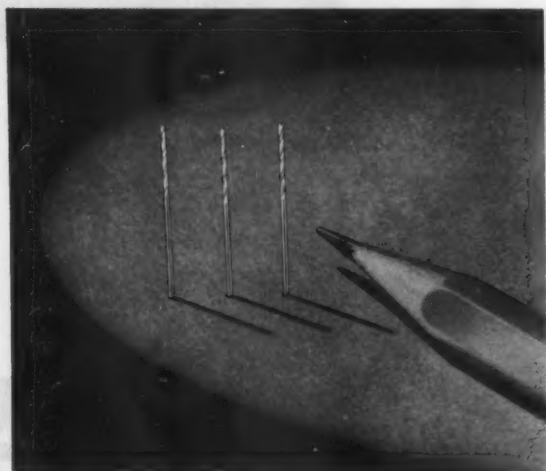
Circle Item 598 on inquiry card

Boring Heads with Piloted Shanks

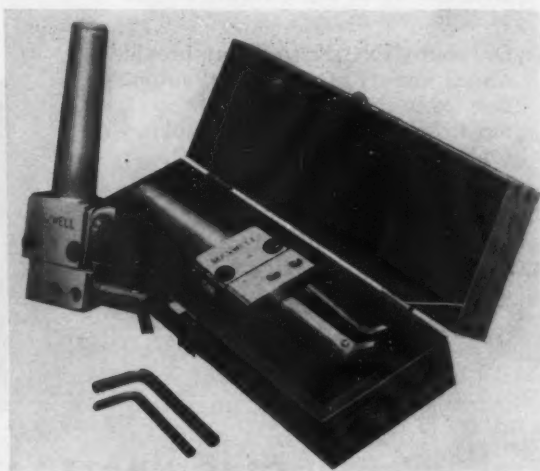
Boring heads with piloted type interchangeable shanks and high metal strength in both the body and tool-block sections have been announced by Maxwell Industries, Inc., Ashtabula, Ohio. The boring-head bodies of these tools are made from a single solid piece of steel with its three-position tool-block now being made with a larger, sturdier, adjustable dovetail precision-ground for greater accuracy and hardened for longer life. Fitted to the body without any gib, the head is said to have greater strength and support for the cutter bars and bits.

Two clamping screws are so arranged that all the cutting strain is against solid metal to assure positive, precise locking. By simply adjusting these screws, pressure is exerted directly on the dovetail up to any tension necessary for secure locking. Interchangeable piloted type shanks that assure the concentricity of the tool-holder permit every shank to fit every other tool. Instead of only having the shank screwed directly into the body, the new design machines have a special internal piloting diameter into which the piloted section of the shank is a tight fit. This not only provides a rigid hold on the boring head but also assures the concentricity of the tool-holder at all times.

The adjusting screw is made of



Series 1815 solid-carbide, precision-ground "Micro-Drills" made by the Atrax Co.



Boring head with piloted interchangeable shank made by Maxwell Industries, Inc.

ANOTHER EXPANSION to Better Serve Industry in the Soaring Sixties



PLANT No. 4—ELK RAPIDS, MICHIGAN



PLANT No. 2—DETROIT, MICHIGAN



PLANT No. 3—MANCERONA, MICHIGAN

The recent opening of our Plant No. 4 in Elk Rapids, Michigan, marks the fourth expansion in our manufacturing facilities since we set up in business 35 years ago. In the intervening years, we have earned an international reputation for designing and building money-saving machine tools for many types of industries. We have also diversified our engineering and production talents so that our machines, which originally were specialized in metal-cutting operations, now reach into the nuclear power, electronic, chemical, drug, cosmetic and food industries and are used in processing many household products in everyday family use. To the many people who have helped us build this business, we say, "Thank you, sincerely."

SNYDER CORPORATION

and our subsidiary

ARTHUR COLTON COMPANY

3400 E. Lafayette Avenue • Detroit 7, Michigan

PLANT NO. 1—DETROIT, MICHIGAN



chromium-molybdenum alloy steel. It is hardened and has the thread ground from the solid. The head of the adjusting screw is calibrated to 0.050-inch offset per revolution and has a vernier for quick, accurate settings to 0.0001 inch. A broached hole for a socket wrench is provided to facilitate adjustment. An individual screw nut permits adjustments to be made for wear without dismantling the tool.

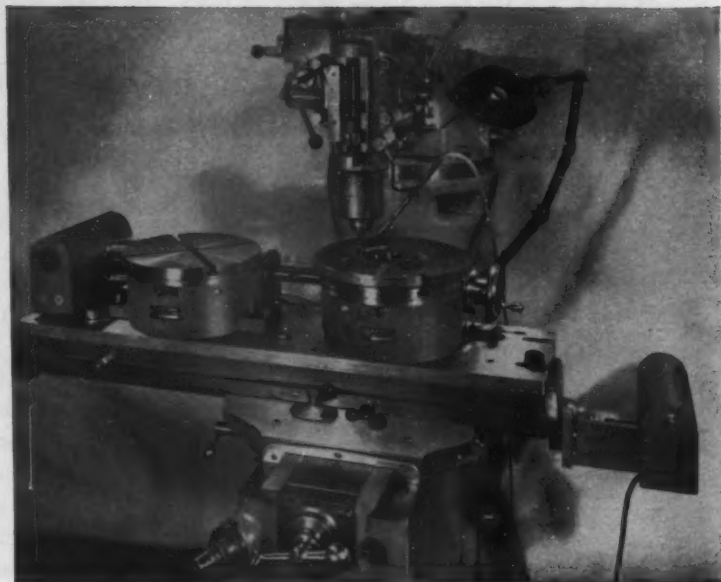
The new boring head will accommodate both 1/2-inch (Model 50) and 3/8-inch (Model 50A) round tools. Boring heads are also available for tool sizes from 3/8 inch to 1 1/2 inches in standard units and up to 3 inches in special sizes.

Circle Item 599 on Inquiry card

Spline-Drive Armatures for Heavy Duty

A line of spline-drive armatures for use on integral horsepower electric clutch-coupling and brake applications where shock- or vibration-loading are problems is announced by Warner Electric Brake & Clutch Co., Beloit, Wis. Spline-drive armature assemblies are now being made available in 8-, 10-, 12-, and 15-inch diameters. They can be used on many special clutch applications where the equipment builder or user furnishes the male splined hub.

No mounting adjustment is required, the armature being simply pressed tight against the magnet face at the completion of mounting and on release the air gap is



Roto-Mill announced by the M & M Tool & Mfg. Co.

set automatically by the autogap spring. Fig. 1 shows the split bushing being inserted in the splined hub. Cap-screws passing through clearance holes in the flange of the bushing secure it to the hub but do not drive the hub, and so escape shear stress. A retainer ring keeps the armature from being backed off too far. Fig. 2 shows the bushing after it is secured on the shaft and the armature of the Warner spline-drive unit has been pushed against the magnet face. On releasing the armature the autogap spring provides the 1/32-inch gap setting.

Circle Item 600 on Inquiry card

Roto-Mill Precision Milling Table Designed for Making Cams or Duplicating

A Roto-Mill which is essentially a precision milling table designed for single, double, or triple operation for duplicating or making cams has been announced by the M & M Tool & Mfg. Co., Dayton, Ohio. This mill can be used in a vertical position for special jobs or as a fixturing plate for milling slots in parts, etc. A 110-volt, 60-cycle motor with forward and reverse as well as variable-speed controls permits selection of the proper cutting speed. Gradua-



Fig. 1. Inserting split bushing in splined hub of Warner spline-drive armature is a simple operation



Fig. 2. Bushing secured on shaft of spline-drive with armature and drive pushed against magnet face

NEW *from* **GRAND RAPIDS**

and just look at all these features:

- Powered vertical movement of wheel head*
- Instantly variable hydraulic table speed
- Greased-for-life precision ball bearing spindle with two speeds for long wheel life
- Equipped with Vickers vane type pump and our own control valve for infinite longitudinal table speeds from 5" to 120' per minute
- Variable speeds hydraulic cross feed and continuous cross feed
- Rugged, one-piece casting column and base for permanent rigid alignment
- Bijur one-shot lubricating system eliminating hand oiling
- Ultimate in accuracy with micro inch finish at production speeds

***AUTOMATIC DOWNFEED AVAILABLE AS OPTIONAL FEATURE**

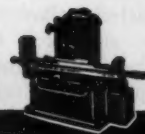
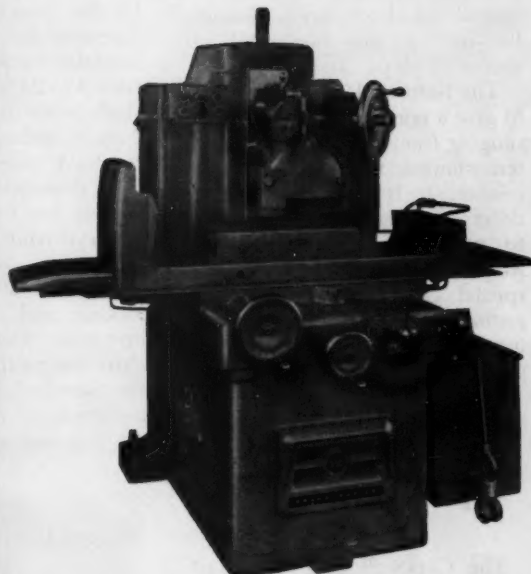


For full details, just send a note on your letterhead.

GALLMEYER & LIVINGSTON CO.
305 Straight Ave., S.W., Grand Rapids, Mich.

MACHINERY, January, 1960

No. 350 PRECISION TOOL ROOM TYPE HYDRAULIC FEED SURFACE GRINDER



**GALLMEYER
& LIVINGSTON**

For more data circle this page number on card at back of book



Geneva drive mechanism made in various sizes by the Genevomatic Engineering Corporation



Heliweld electrode holder of small size announced by Air Reduction Sales Co.

tions are provided and micro switches can be attached to stop and reverse table movement. A special slip clutch can be provided for milling slots accurately by means of stops, etc.

The Roto-Mill can be purchased to give a number of milling speeds ranging from one revolution every ten minutes to six revolutions a minute. It is available in many different types and can be made to suit customer's requirements. Ample torque is developed by a special gear drive. Backlash adjustment assures accuracy in milling. The drive unit is sealed in grease and needs no oiling.

Circle Item 601 on inquiry card

Capewell "Speed-Band" Saw Blades

The Capewell Mfg. Co., Hartford, Conn., has brought out a band-saw blade called the "Speed-Band" which is the first to be produced from a new alloy designated L-100-M. This carbide alloy has been specifically designed for these blades. It has been formulated to deliver optimum performance by embodying those characteristics best adapted for economical sawing.

The hot hardness and abrasion resistance of this alloy are said to make possible higher speeds and feeds on standard carbon band-saw cutoff machines. These qualities also serve to increase the range and types of materials which can be cut as well as to increase cutting speeds.

Circle Item 602 on inquiry card

Drive for Indexing Tables

Standard Geneva drives made by the Genevomatic Engineering Corporation, Tampa, Fla., are available for applications requiring from 3 to 24 indexing stations with shaft center distances ranging from 3 to 6 inches in 1/4-inch increments. A wide variety of hub and bore diameters is available. Steel wheels are furnished with Meehanite driving wheels.

The new drives are designed to insure accurate indexing, positive locking, and smooth, trouble-free operation. Center distances less than, intermediate, or greater than the standard 3- to 6-inch range are available upon request.

Circle Item 603 on inquiry card



Section of Speed-Band band saw

Small-Size Heliweld Holder

A 350-ampere, water-cooled, manual Heliweld (tungsten-inert-gas process) holder which is as small as most conventional 200-ampere holders has been marketed by the Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Designated the H35-B, it can be used to weld stainless steel, aluminum, copper, magnesium, and other special metals and alloys in sheets of paper thickness up to 1/8 inch thick or more, depending on the metal and type of current employed.

This holder has a completely enclosed water-cooling system designed to minimize leakage and which requires no "O" rings. Transparent plastic tubing is used on all hose assemblies to allow a visual check on water flow at all times. The high-temperature plastic holder body is designed to withstand service temperatures up to 500 degrees F. Hoses are equipped with nuts and glands for easy removal.

The holder is rated at 350-ampere direct current, straight polarity, and 300-ampere alternating current. Tungsten electrodes 0.020 through 5/32 inch in diameter in lengths from 2 through 7 inches can be used with argon, helium, or mixtures of these shielding gases. The holder is easy to use in confined spaces and has a minimum of 2 7/8-inch interference dimension when using a 2-inch collet cap assembly and short nozzles. Stub loss is less than 13/16 inch when using short nozzles.

Circle Item 604 on inquiry card

Another Elmes

PROFIT-MAKING ANSWER to a Pressing Problem!

Maybe you aren't a producer of aluminum (or likely as not you'd be among the many who have this installation), but the *profitable* manufacture of *your* product may be a real headache to your production men. *That's the time to call on Elmes!*

Elmes engineers have an outstanding reputation for providing installations that effect lowest-cost operation on all kinds of production problems involving the use of presses. It may be that your particular need can best be met by a standard design Elmes® Hydraulic Press—or a standard design with modifications. Or perhaps the job is so unusual that a special custom-built unit is required. In any case, *Elmes will furnish a "Job-Fitted" press that will meet the specific requirements exactly.*

When you work with Elmes, you get the advantage of more than 60 years of leadership in hydraulic service—over 100 years of acknowledged excellence in manufacturing craftsmanship. Talk over *your* pressing problems with your nearby Elmes Distributor, or write to us direct.

American Steel Foundries

Elmes
ENGINEERING DIVISION

1162 Tennessee Avenue, Cincinnati 29, Ohio

METAL-WORKING PRESSES • PLASTICS MOLDING PRESSES •
PUMPS • ACCUMULATORS

The problem: Copper anode rods, used in processing aluminum, are usually bent or distorted after removal from the reduction furnace. Manual straightening of the rod and delta (which holds the carbon block) and removal of the thimble took too long and was costly in labor consumed.

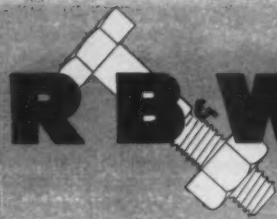
The Elmes answer:



(Above) Fully automatic Elmes Anode Rod Straightening Press in the plant of a leading producer of aluminum. (Below) Companion unit, Elmes Thimble Removal Press, completes the automated setup for reconditioning the anode rods.

A special, fully automatic Elmes Anode Rod Straightening Press (shown above) with a unique set of dies straightens the rod and aligns the delta within commercial tolerances in one pass through the press on an overhead conveyor. A companion fully automatic Elmes press (illustrated at right) then removes the cast iron thimble, used to hold the carbon electrode to two forged steel stubs.





FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY



Technicalities

By John S. Davey

The strength of nuts

With a hard, heat treated nut, ability to plastically adjust and distribute load over many threads diminishes. High loads tend to concentrate on first thread severely enough to cause stripping... or fracture of first thread, which causes locking. Nut then cannot increase tension in bolt.

Untreated nuts are strong enough for most needs, and don't pose this problem.

A CAUSE OF STRIPPING

Upon tightening, a nut both compresses and dilates. Dilation can be overcome by wall thickness only, not by added height or heat treatment.

Dilation is important since a reduction in area of bolt under tension accompanies it. Threads pull away from each other, from their stronger base to weaker tips. The shallowness of fine threads can cause progressive shear.

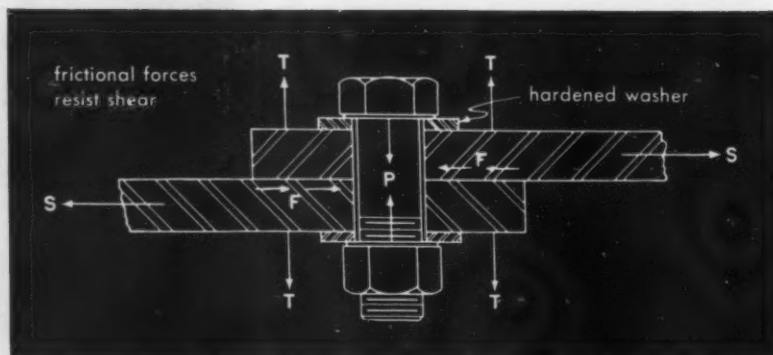
That's why High Nuts (with fine threads) are no answer where "Heavy" Nuts (with coarse threads) are.

WRENCHING STRESS HIGHEST

Rotation of nut produces both tension and torsion in bolt. The force applying this combined stress is about 20% greater than the load which must be sustained when rotation stops.

Thus... if a nut hasn't failed in wrenching, it can still withstand at least 20% more direct pull than it sustained during the tightening.

Why high strength bolts make superior joint for dynamic loads



Washers prevent crushing under head and nut with consequent grip relaxation.

While fasteners must be strong enough to carry the calculated loads, what makes a joint truly strong is the residual tension after wrenching.

NO SLIP OR SEPARATION

Consider the simple lap joint in sketch. Practically rigid, this joint is subjected only to: (1) external tension forces "T" tending to separate the plates against bolt clamping force "P"; (2) shear forces "S" tending to make plates slip against friction resistance "F".

"F" increases when "P" does. With enough clamping force applied, shear loads transfer from one plate to the other without slippage. And when clamping force always exceeds tensile forces, plates obviously *cannot* separate. There can be no further stretch on bolt. Its load stays static at preload "P", even when external loads are dynamic.

UNIFORM CONTROL OF PERFORMANCE

RB&W high strength bolts allow a high magnitude of clamping force to be applied... and *uniformly* so. Materials conform to ASTM specifications. Applying known torques to nut produces uniform bolt tensions. Riveting by contrast, depends on difficult-to-control variables.

MORE STRENGTH OVERALL

For shear-resistance, riveted joints offer only the actual rivet shear strength. Don't count too much on

friction even though rivets exert some grip as they cool. Compare: a 1-inch bolt tightens to a tension of 42,000 lbs; a 1-inch rivet develops 22,000 lbs at best.

The higher residual tension also protects the bolt against fatigue caused by stress-reversing cycles such as vibration.

All this explains why, under heavy dynamic loads, rivets can loosen, elongate holes, often fail, requiring difficult replacement; but high strength bolts stand up. They can keep connections permanently tight on vibrating machinery, heavy duty conveyors, and transportation equipment.

Talk it over with an RB&W fastener expert. Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.



RB&W high strength bolts are from selected grade of medium carbon steel with proper combination of ductility and tensile strength. They conform to ASTM A325.

Plants at: Port Chester, N.Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

catalogues bulletins manuals

Yours for the asking. . . Use postcard inside back cover



Trucks

Palmer-Shile Co., Detroit, Mich. Folder outlining the advantages of trucks engineered and manufactured for specific plant and warehouse materials-handling problems. It describes underslung trailers for drums and other heavy units, etc.

Circle Item 501 on Inquiry Card



Hardness Tester

Torsion Balance Co., Clifton, N. J. Bulletin describing the Kentron micro hardness testers. These instruments apply dead-weight loads from 1 to 1000 grams. (Additional weights for applying heavier loads up to 10,000 grams can be furnished.)

Circle Item 502 on Inquiry Card



Heat Exchangers and Steam Jets

National Carbon Co., a division of Union Carbide Corporation, New York City. Catalogue Section S-6620, describing Karbate impervious graphite, immersion heat exchangers and circulating steam jets for heating or cooling corrosive solutions in all types of tanks.

Circle Item 503 on Inquiry Card



Pre-setting Tool

Parker-Hannifin Corporation, Parker Fittings & Hose Division, Cleveland, Ohio. Catalogue Sheet No. 1149A6, describing the collar type Ferulset tool introduced by the company, designed to make the pre-setting of "bite" type fitting ferrules onto tubing easier.

Circle Item 504 on Inquiry Card



Compressors

Cooper-Bessemer Corporation, Mount Vernon, Ohio. Bulletin 91, describing the features of Cooper-Bessemer AM/2 and AM/4 packaged compressors for gas gathering. It discusses the incorporation of large compressor concepts in these compact, heavy-duty units.

Circle Item 505 on Inquiry Card



Casting

Arthur Tickle Engineering Works, Inc., New York City. Brochure entitled "Bi-Metallic Casting by Tickle," which presents a widely used method of metallurgically bonding dissimilar metals by the "Al-Fin" process. This method has been successfully applied.

Circle Item 506 on Inquiry Card



Carriage Tracer

Jones & Lamson Machine Co., Springfield, Vt. Brochure describing a two-dimension carriage tracer for J & L turret lathes. It has four completely automatic tracing cycles. This tracer is available on J & L No. 7A saddle type turret lathes.

Circle Item 507 on Inquiry Card



Control Valves

Ross Operating Valve Co., Detroit, Mich. Digest catalogue—a condensation of the general catalogue of Ross air valves, presenting information on all standard models, with envelope dimensions, model numbers, pipe sizes, JIC symbols, and other specifications.

Circle Item 508 on Inquiry Card



Inspecting by Reflection

Jones & Lamson Machine Co., Springfield, Vt. Brochure describing the company's normal reflection unit for FC-14 and TC-14 models of the J & L optical comparator, a new development in surface illumination. A feature is the use of special heat-absorbing glass.

Circle Item 509 on Inquiry Card



Drill Series

Whitman & Barnes, Plymouth, Mich. Folder announcing a new series of drills specifically designed for production drilling of hard materials now commonly being used in the aircraft and missile industries. They are made of 8 per cent cobalt high-speed steel.

Circle Item 510 on Inquiry Card



Tapping Guide

Jarvis Corporation, North Attleboro, Mass. Slide chart called the "Tap Selector," allowing the user to quickly select the correct tap for most tapping jobs. The selector indicates the proper size to use for a desired class of fit, the tap drill size, tapping speeds, etc.

Circle Item 511 on Inquiry Card



"Verti-Slide" Machine

Machine Division, Torrington Mfg. Co., Torrington, Conn. Technical bulletin giving detailed operating features and specifications for the new V-81 Verti-Slide vertical four-slide machine. Machine components described include the unique cam timing disc, etc.

Circle Item 512 on Inquiry Card

(This section continued on page 190)

Yours for the asking. . . Use postcard inside back cover



Superalloy

Kelsey-Hayes Co., Metals Division, New Hartford, N. Y. Brochure presenting performance data on M-252, a vacuum-induction-melted alloy for heavy-duty, high-temperature applications. Chemical composition and physical constants are given.

Circle Item 513 on Inquiry Card



Band-Saw Blades

Capewell Mfg. Co., Hartford, Conn. Folder describing "Speed-Band," a new concept in band-saw blades. They are produced from a new alloy, L-100-M, which is specifically designed for this type of blade. The alloy permits use of higher speeds and feeds.

Circle Item 514 on Inquiry Card



Electrodes

Harnischfeger Corporation, Milwaukee, Wis. Bulletin R-49, giving full specifications on an extended line of stainless electrodes covering all AWS-ASTM types. These all-position, low-spatter electrodes permit easy slag removal.

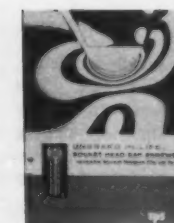
Circle Item 515 on Inquiry Card



Tool-Holder

Burgmaster Corporation, Gardena, Calif. Bulletin presenting a complete line of "Tool-flex" full floating tool-holders. The Tool-flex line consists of three standard types of fifty-one individual models: general purpose, tap holder, and threaded adjustable.

Circle Item 516 on Inquiry Card



Industrial Fasteners

Standard Pressed Steel Co., Jenkintown, Pa. Folder describing the Unbrako "Hi-Life" thread—a recent advance in industrial fasteners. It depicts the change from the old flat-root thread form to Hi-Life's controlled thread root form.

Circle Item 517 on Inquiry Card



Rebuilt Machine Tools

Miles Machinery Co., Saginaw, Mich. Catalogue No. 212, listing machine tools that have been rebuilt and others that are in the process of being rebuilt. Included are automatics, drills, gear hobbars, grinders, lathes, milling machines, and others.

Circle Item 518 on Inquiry Card



O.B.I. Press Line

Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin 53, presenting the company's line of Series AF inclinable presses, featuring an instant-engaging, low-inertia friction clutch and brake. Standard and optional features are given.

Circle Item 519 on Inquiry Card



Versatile Punch

Whitney Metal Tool Co., Rockford, Ill. Folder describing the No. 118 Whitney-Jensen hand metal bench punch with adjustable ram, throat depth of 7 inches, and throat height of 4 1/2 inches, which increases the number of jobs this punch can handle.

Circle Item 520 on Inquiry Card



Generator

Sight Feed Generator Co., West Alexandria, Ohio. Brochure presenting the newest addition to a line of acetylene generators. Carbide manufacturers now have 2-inch by 0-inch (run-of-crusher) carbide for acetylene generation. A new unit accommodates this new size.

Circle Item 521 on Inquiry Card



Lathes

Nebel Machine Tool Corporation, Cincinnati, Ohio. Bulletin 211 describing a new lathe, Model HXB 26/45. It gives complete features and specifications on the new heavy-duty extension-bed gap lathe, built to ASA standards of accuracy and tolerance.

Circle Item 522 on Inquiry Card



Special Steels

Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Booklet presenting aircraft steels AM-350 and AM-355. It gives details on these steels as to their mechanical and physical properties at various temperatures. Also included are sections on heat-treating, etc.

Circle Item 523 on Inquiry Card



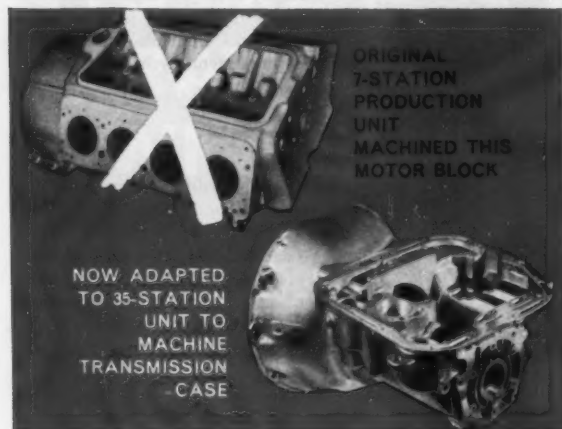
Soldering Supplies

Johnson Mfg. Co., Inc., Mount Vernon, Iowa. Catalogue C-1 containing complete descriptions of fluxes, solders, and supplies for all soldering applications. Products shown include general purpose, stainless-steel, aluminum, rosin, and noncorrosive fluxes, etc.

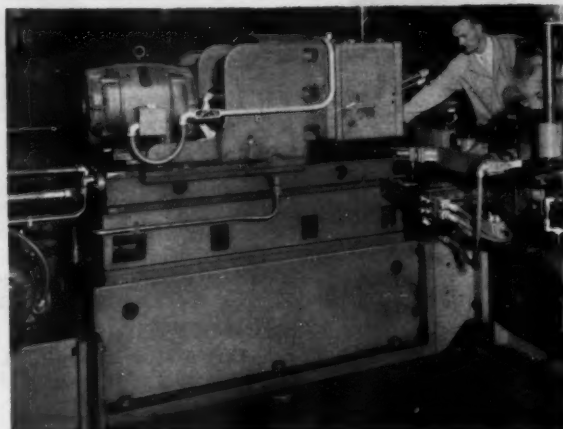
Circle Item 524 on Inquiry Card

(This section continued on page 192)

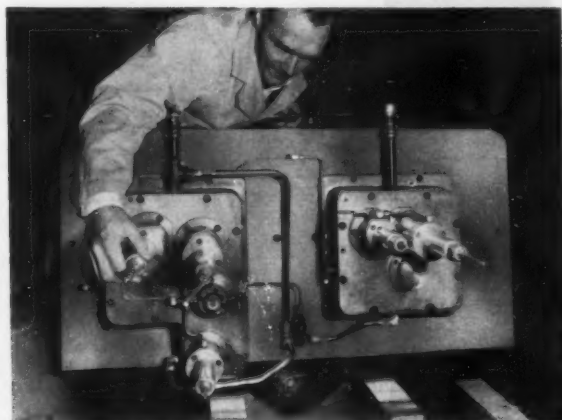
HOW **BARNESDRIL** PRODUCTION UNITS SAVE MONEY THROUGH FLEXIBILITY!



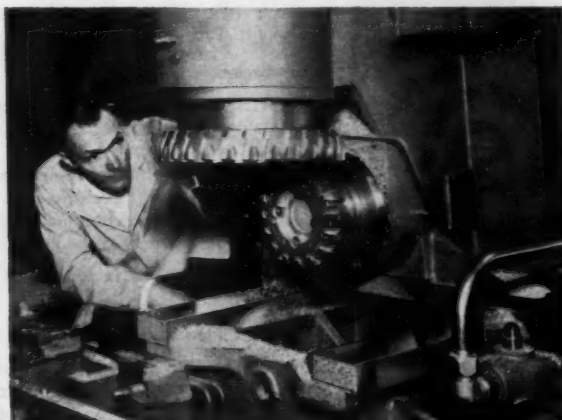
Barnesdril units regroup easily . . . economically. A leading automobile manufacturer, for instance, is reducing the costs of tooling for a new transmission case by using Barnesdril units from an obsolete motor block line built to the "Building Block" principle. "Before and after" parts are illustrated.



This "obsolete" unit will go right on producing! That's because Barnesdril unit and slide assemblies are separate. Base and column sections are separate, too, for widest possible flexibility. Units have inserted hardened and ground steel ways, with saddle type construction to reduce height of auxiliary heads.



By simply replacing the "pot" this unit can be adapted to major styling changes. All "pot type" heads are used on this line. Pallets used to hold the work fixtures also can be re-used when the machine is rebuilt. Since pallets rise very little from the rest pad for indexing, they automatically sweep chips into the flume.



This duplex milling head is combined with drilling, tapping, reaming, boring, and facing units on the new 35 station machine. Gross production rate is one case every 36 seconds. For easy maintenance, hydraulic cylinders on Barnesdril units can be removed by loosening 4 bolts and uncoupling the tie rod.

Get the complete story in cost-cutting Barnesdril Production Units . . . write for catalog 150-D Today!



Honing Machines / Production Units / Filtration Units / Drilling Machines

BARNES DRILL CO.

820 Chestnut Street • Rockford, Illinois
DETROIT OFFICE — 13121 Puritan Avenue

Yours for the asking. . . Use postcard inside back cover



Solid-Carbide Drills and Reamers

M. A. Ford Mfg. Co., Inc., Davenport, Iowa. Bulletin containing illustrated and technical descriptions of four series of solid-carbide drills and a series of solid-carbide reamers. Featured is the "Hi-Roc" drill, engineered for production work in hardened steel.

Circle Item 525 on Inquiry Card



Special Alloy

Kelsey-Hayes Co., Metals Division, New Hartford, N. Y. Bulletin describing "Waspaloy," a vacuum-melted alloy for specially corrosive high-temperature applications. Information is given about sizes and forms available, and a three-step heat-treatment cycle.

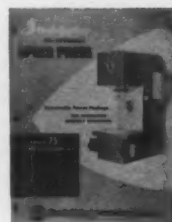
Circle Item 531 on Inquiry Card



Silicone Rubber

General Electric Co., Waterford, N.Y. Bulletin CDS-208, entitled "Why and Where It Pays You to Use Cable Insulated With General Electric Silicone Rubber," which lists the insulated properties of G-E Class 900 electrical-grade silicone rubber.

Circle Item 526 on Inquiry Card



Presses

Studebaker Hydraulic Products Co., Melrose Park, Ill. Bulletin No. AH-98 featuring the Model AH-1000 10-ton and Model AH-500 5-ton air-hydraulic speed presses, with "dual stage power package" and ram assembly. Optional equipment is included.

Circle Item 532 on Inquiry Card



Form Grinder

Jones & Lamson Machine Co., Springfield, Vt. Brochure describing the firm's Model E2 automatic form grinder. It is specifically designed for high production precision plunge grinding up to 31 inches in length. It is also adaptable for other work.

Circle Item 527 on Inquiry Card



Boring and Grinding Machines

Heald Machine Co., Worcester, Mass. Condensed general catalogue 1-2, describing the basic design features of all Heald machines. It covers the various models of Bore-Matics, internal grinders, rotary surface grinders, tool sharpeners, boring- and wheel-heads, etc.

Circle Item 533 on Inquiry Card



Press Brakes

Dreis & Krump Mfg. Co., Chicago, Ill. Catalogue presenting Chicago steel hydraulic press brakes from 100 to 2000 tons. All hydraulic components are protected by pressure-control valves. Electrical and hydraulic equipment is an integral part of the machine.

Circle Item 528 on Inquiry Card



Lenses and Optical Systems

Simpson Optical Mfg. Co., Chicago, Ill. Booklet describing how lenses are made by the company for all phases of industry. Optical coatings, systems, and lens mountings are also discussed. Lens manufacture, from generating through polishing, is described in detail.

Circle Item 534 on Inquiry Card



Rack and Pinion Roll Feeds

Automation Division, F. J. Littell Machine Co., Chicago, Ill. Catalogue describing the company's rack and pinion roll feeds for O.B.I. presses. Covered are: operating and economical advantages of automated press operation, and principles of roll-feed design.

Circle Item 529 on Inquiry Card



Accessories

Brown & Sharpe Mfg. Co., Providence, R. I. Catalogue No. 37A featuring machine-shop accessories. It lists arbors, adapters, collets, and other machine shop accessories which the company manufactures. The listings of these products have been improved.

Circle Item 535 on Inquiry Card



Dry Coolant

King Graphite Products, Inc., Trenton, Mich. Folder describing a new treatment for grinding wheels which retards loading and functions as a dry coolant. Once the wheel has been impregnated in "Dri-Kool," its pores are coated with a parting medium.

Circle Item 530 on Inquiry Card



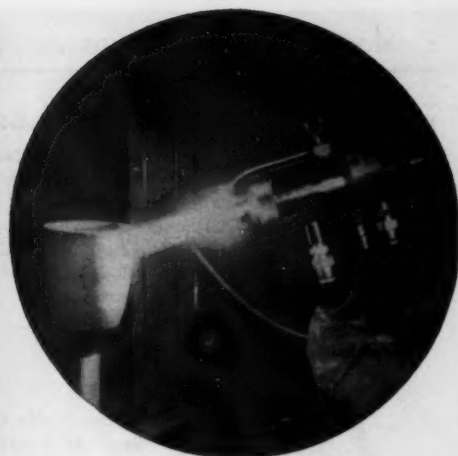
Sensing Control

Security Controls, Inc., Buffalo, N.Y. Bulletin 400, presenting an electronic sensing control for detecting, counting, measuring, and recognizing objects as they enter a capacity field. Described are method of operation, details of components, and sixteen applications.

Circle Item 536 on Inquiry Card

(This section continued on page 194)

NOW — 15,000°F. PLASMA FLAME SPRAY IN YOUR OWN PLANT



Flame spraying hi-temperature crucible

Apply coatings of high melting point materials such as tungsten, tungsten carbide, molybdenum, chromium carbide, titanium oxides, calcium zirconate, rare earth oxides. Operates at 10,000° — 15,000°F.

Now any material that can be melted without decomposing can be sprayed. Despite high melting temperature, object sprayed stays cool.

High fluidity of particles and high velocity of impingement bond particles together to produce high density coatings semi-fused to work surfaces. Absence of air eliminates oxidation.



Spraying tungsten on brass mandrel



Tungsten coated graphite part

Metco Type MB Plasma Flame Spray Gun

Here is a valuable new tool for the metalworking research department or production line. The METCO Plasma Flame Spray Gun operates on inexpensive inert gases, with high electrical power conversion efficiency and long component life. Continuous hot gas streams, as high as 30,000°F., with accurate control of temperature, can be generated for costs of 1/3 to 1/2 those of oxygen-fuel gas equipment for equivalent heat output.

Other advantages include push-button operation, extremely simple training of personnel, elimination of flash-back and explosion problems.

Materials that can be sprayed

Specifically, a wide range of metals and their oxides, carbides, borides, and refractories have been sprayed

Plasma Flame — how it works

The METCO Plasma Flame Spray Gun produces an arc contained in a water-cooled nozzle. An inert gas, blown through and around the arc, is "excited" to energy states having temperatures approaching 30,000°F. This Plasma "Flame" is used for melting and spraying any desired material.

with the standard apparatus on various shaped objects and mandrels. Coating densities are easily controlled and up to 98% of theoretical can be obtained. Lowered oxide contents, with improved bond and tensile strengths are additional advantages.

The METCO Plasma Flame Gun is the latest development in flame-spraying equipment by METCO. Write today for free bulletins describing the various flame spraying processes and the Plasma Flame Spray Gun.

Metallizing Engineering Co., Inc.



Flame Spray Equipment and Supplies
Westbury, Long Island, N. Y. • Cable: METCO
Telephone: EDgewood 4-1300
In Great Britain: METALLIZING EQUIPMENT CO. LTD.
Chobham-Near-Woking, England

Metallizing Engineering Co., Inc.
1131 Prospect Ave., Westbury, L. I., New York

Please send me free bulletin on the Metco Plasma Flame Spray Gun.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

Yours for the asking. . . Use postcard inside back cover



Automatic Conveyor Lubricators

J. N. Fauver Co., Inc., Detroit, Mich. Catalogue No. CL 659, describing the new models of the "110 Series" and "700 Series" automatic conveyor lubricators. Three fundamental improvements are included in the design of the "110 Series" models.

Circle Item 537 on Inquiry Card



Hoists

Harrington Co., Plymouth Meeting, Pa. Catalogue R, describing a full line of hoist products for overhead handling of loads from 1/4-ton through 60 tons. It covers more than twenty different kinds of cranes, hoists, and specialty and accessory items.

Circle Item 543 on Inquiry Card



Shear Knives

American Shear Knife Co., Homestead, Pa. Brochure describing a full line of shear knives for all metal-cutting applications. It features descriptive sections on each of six grades of A.S.K. shear knives, together with company's recommendations for use.

Circle Item 538 on Inquiry Card



Welding Helmets

Sellstrom Mfg. Co., Palatine, Ill. Bulletin 35-H, featuring the company's line of fiber glass welding helmets. The firm's new nylon lift-front and stationary plate retainers and ratchet Sel-O-Matic plastic headgear are described. Included are data on replacement plates.

Circle Item 544 on Inquiry Card



Pumps

Ruthman Machinery Co., Cincinnati, Ohio. Catalogue No. 59A featuring a line of industrial coolant pumps (immersed type) and accessories. Dimensions and capacities are given and performance curves are charted. These pumps are motor-driven.

Circle Item 539 on Inquiry Card



Drives

Browning Mfg. Co., Maysville, Ky. Catalogue GB-201-A, covering a line of Browning "Gearbelt" drives, which combine the flexibility of belt drives with the advantages of chain and gear drives. Design suggestions and tables of stock drive combinations are included.

Circle Item 545 on Inquiry Card



Steel Analyses

Jones & Laughlin Steel Corporation, Stainless and Strip Division, Detroit, Mich. Pocket guide listing the compositions of forty stainless steels, 184 alloy steels, and 105 carbon steels most often used in industry. It also contains important Federal specifications.

Circle Item 540 on Inquiry Card



Magnetic Separators

S. G. Frantz Co., Inc., Trenton, N. J. Catalogue telling how to solve your filtering problems involving the removal of ferrous grit from hydraulic systems, by means of high-pressure "Ferrofilter" magnetic separators. Data sheets and price lists are supplied.

Circle Item 546 on Inquiry Card



Gear Generators

Consolidated Machine Tool Division, Farrel-Birmingham Co., Inc., Rochester N. Y. Bulletin 460, describing and illustrating the complete line of Farrel-Sykes gear generators. Included are complete specifications of all models and a description of design features.

Circle Item 541 on Inquiry Card



Conductor Systems

Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio. Bulletin No. 2016-D, describing "Safpowrbar" conductor systems for providing electrification of maximum safety and long life on overhead materials-handling equipment.

Circle Item 547 on Inquiry Card



Fasteners Division

Engineered Fasteners Division, Townsend Co., Ellwood City, Pa. Brochure describing production facilities, plants, and products of the newly organized Engineered Fasteners Division. Featured are the complete line of mechanical fasteners and cold-headed parts.

Circle Item 542 on Inquiry Card



Stainless Steel

Union Carbide Metals Co., Division of Union Carbide Corporation, New York City. 88-page booklet, called "Buyer's Guide for Stainless Steel Consumer Products," listing over 500 consumer products made of stainless steel. It covers items in the automotive field.

Circle Item 548 on Inquiry Card

IT'S LIGHTER THAN YOU THINK!



**...RIGID, RATTLE FREE
and EASY TO ASSEMBLE
WHEN DIE CAST with**



ZAMAK

Light-weight, ZINC die cast instrument housings are finding extensive use in 1960's precision-engineered automobiles. Designed for the new MERCURY, this is an excellent example of the way automotive engineers are getting the most value—at low cost—from a single, rigid, rattle free and easy-to-assemble unit.

Integrated designing of panels and instrument clusters for ZINC die casting eliminates the cost of sub-assemblies and extra parts, unitizes instrumentation, provides space-saving facilities for wiring and saves weight. In this one complex, thin-wall,

ready-to-use ZINC die casting are integrally cast bosses and studs for rapid assembly, framing members and supports for finish pieces.

Here, as in many other applications, rugged but extremely thin-wall sections—possible only with ZINC die castings—minimize weight and are stronger in proportion to thickness than heavier sections. Weighing only 7½ pounds, the over-all measurements of this MERCURY instrument cluster are 22½" long, 12" high and 6½" deep, with a minimum wall thickness of .037".

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY

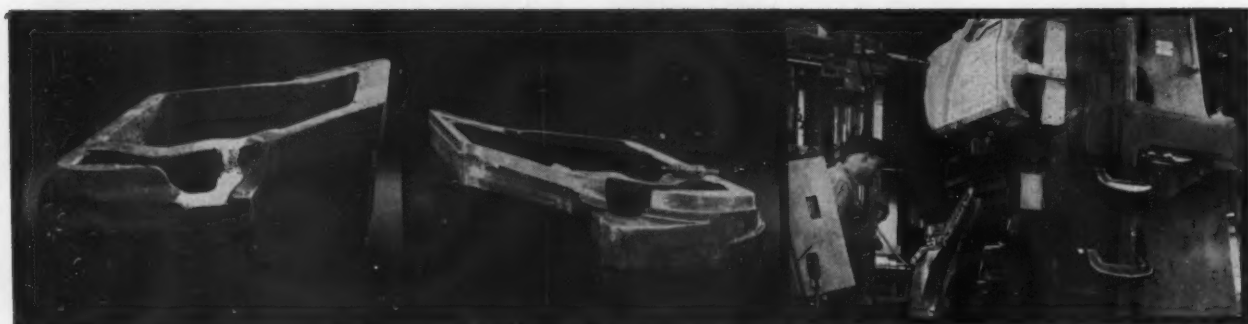
THE NEW JERSEY ZINC COMPANY

DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY

160 Front Street • New York 38, N. Y.



ACCURACY



MASSIVE, ROUGH CASTINGS . . . are machined quickly and efficiently on the Barth Corporation's big, powerful BG-21 KELLER Automatic Tracer-Controlled Miller.

ACCURATE MACHINING . . . on the KELLER Machine means that this big automotive die will require only a minimum of barbering.

INTRICATE 3-DIMENSIONAL SHAPES . . . like the job shown here, are duplicated quickly and accurately, as the cutter follows the sensitive tracer.

ASSURED...

... AND INTRICATELY CONTOURED DIES
PRODUCED QUICKLY, ECONOMICALLY WITH

KELLER

Automatic Tracer-Controlled Millers

TRADEMARK®

One of the country's largest tool and die manufacturers, the Barth Corporation, of Cleveland, Ohio, has depended for many years on KELLER Automatic Tracer-Controlled Millers to produce large, intricately contoured dies for the automotive, aircraft-missile, appliance and other industries.

Shown opposite with one of his company's KELLER Machines, Mr. John Barth — Vice President and General Manager of Barth Corporation and newly elected President of the National Tool and Die Manufacturers' Association — states, "KELLERS do intricate die jobs not otherwise possible and do them quickly and accurately. In our plant, these machines are highly regarded and are considered the only machines for the job."

At Barth Corporation, KELLER Automatic Tracer-Controlled Milling Machines are used to reproduce large plaster full-models in tool steel, with speed, efficiency and economy — producing the dies that will manufacture components for the nation's newest automobiles and appliances. Operation is easy; there is no work spoilage and no maintenance problem.

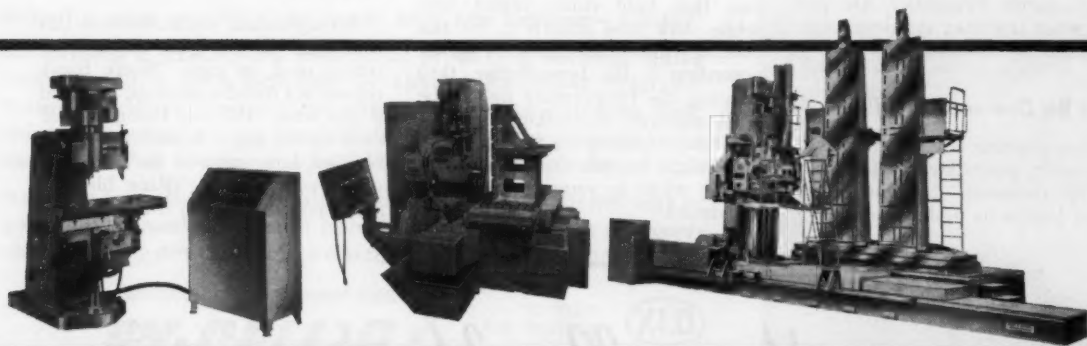
Dies, molds, prototype parts, limited-run production — and anywhere that intricate, 3-dimensional contours must be machined with speed and accuracy — a KELLER Automatic Tracer Controlled Milling Machine can help you turn out better work at lower cost. Write now for complete information, stating the work-size range you require. Pratt & Whitney Company, Inc., 12 Charter Oak Boulevard, West Hartford, Connecticut.



PRATT & WHITNEY®

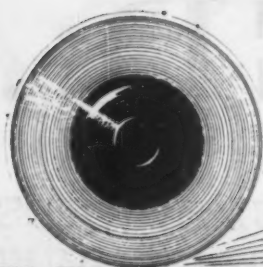
FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS



A COMPLETE LINE OF KELLER MACHINES . . . for every work size requirement is produced by Pratt & Whitney. From the compact Type BL (center) to the giant Type BG-22 (right), they provide travel capacities from 36" x 20" to

20 ft x 7 ft. Also included is the precision VELVETRACE® (left) with non-contacting tracer control capable of duplicating the finest detail to "tenths" accuracy.



By E. S. Salichs

BETWEEN GRINDS

Hapless Talk

We were reading in *Saturday Review* about the science of "Thermodynamics," which, according to Professor Louis Sattler of the Brooklyn College chemistry department, is concerned with innate cussedness of inanimate objects. Lecturers in chemistry have long been irked by the refusal of chemicals to exhibit their "chemical properties" when an audience is watching a demonstration. The professor duly noted this, as well as other irksome observations, such as: the buttered bread falls to the floor, butter side down; the juice from a grapefruit always finds the eye; the pen lands point down on the wood floor. You yourself discover the laws of Thermodynamics as you exasperatedly experience them.

New Dawns for Lawns

A measuring device which predicts lawn wear has been invented by a professor from the University of California. It consists of four revolving corrugated wooden feet (to simulate scuffing), two rollers covered with golf shoe spikes, and a slanting wheel, according to *Industrial Research Newsletter*. Or just about what any lawn is subjected to on a Saturday morning.

Don't Be Dressed to Kill!

Sloppy clothing is a serious hazard in industry, according to the Institute of Industrial Launderers. A missing button on a shirt cuff, a rip

in clothing, a dangling tie—these are just a few of the many invitations to accidents in the shop.

We Dig It

Miner & Miner Consulting Engineers Inc. has its headquarters appropriately enough in Littleton, Colo.

Antique Appeal

A foot-operated trip hammer over 150 years old is an attraction being demonstrated daily at Old Sturbridge Village in New England. There seems to be a revival of interest in antique automobiles, clipper ships, and steam engines, as well as early machine tools. Perhaps people are sustaining the sharp shock of the Space Age by recalling soothing samples of the Earth Age.

Chameleon in the Sky

A scientist at Space Technological Laboratories, Inc., has devised a coating for satellites that will change color for protection, the idea being based on the well-known phenomenon that light colors reflect heat while dark ones absorb it. So this coating will become lighter or darker according to the temperature, thus keeping the temperature inside the shell uniform. Everything for the spaceman, nothing for the earthman—we might happen to like our automobile white in summer and black in winter!

Friendship Pacts and Plaques

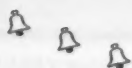
The Canadian Coat of Arms and the American Declaration of Independence will be preserved, virtually forever, in stainless steel by the Jones & Laughlin Steel Corporation. In the form of plaques, they were presented as mementos of the International Freedom Festival to the acting mayor of Windsor and the mayor of Detroit. The plaques are accurate replicas of the originals, achieved through a combination of photolithography and chemical treatment.

Plu Perfect

Plutonium-239 (a primary ingredient of A-bombs and nuclear reactors) is now being used to measure the moisture content of molding sand at the Central Foundry Division of General Motors, and is believed to be the first industrial application of its kind. The general manager of the foundry says that the new technique is solving an ancient problem for foundrymen—that of maintaining a proper moisture content in sand molds.

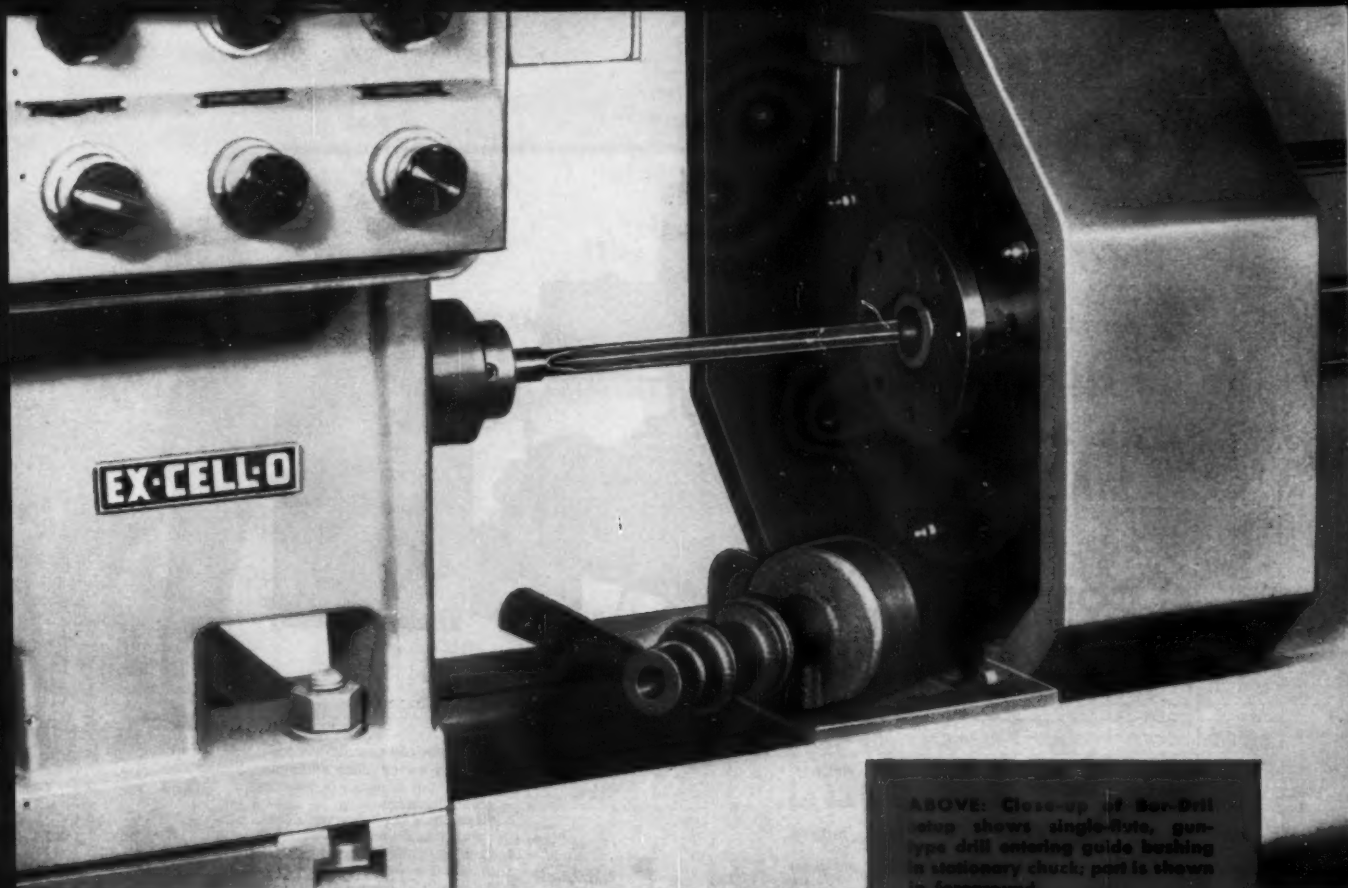
Six, Six, Six

A corporation, unmentionable this time, sent us a release, the title of which read, in caps, "Blank Blank reports sex months earnings." Darned if that wasn't the only typographical error on the page. Rounding out the blunder, however, was the last paragraph which began "Blank Blank is a diversified company . . ."



Happy New Year!





DEEP HOLES FROM THE SOLID, ROUND AND STRAIGHT WITHIN .001" *Bor-Drilled in 30 seconds!*

A cast-iron automotive distributor base in high production requires a central hole $6\frac{7}{8}$ " deep by $\frac{5}{8}$ " diameter. Hold both concentricity and diameter to .001" tolerance; finish the I.D. to 15 RMS or better. How many operations would you specify for the job—drilling, reaming, plus honing or lapping?

Actually, your process sheet needs only one notation—*Bor-Drill!*

Bor-Drilling is Ex-Cell-O's method of producing accurate holes from the solid with standard or special Ex-Cell-O Precision Boring Machines. The process utilizes a rotating gun-type drill; chips are cleared out the single flute of the drill by high-pressure coolant oil fed through the Ex-Cell-O Precision Spindle.

Ask your Ex-Cell-O Representative about this faster, better way to get a finish-machined small hole 12" deep or more in one operation. Or write direct for a free descriptive booklet on Bor-Drilling.

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

EX-CELL-O
FOR PRECISION

Machinery
Division

XLO

59-22

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

ABOVE: Close-up of Bor-Drill setup shows single-flute, gun-type drill entering guide bushing in stationary chuck; part is shown in foreground.

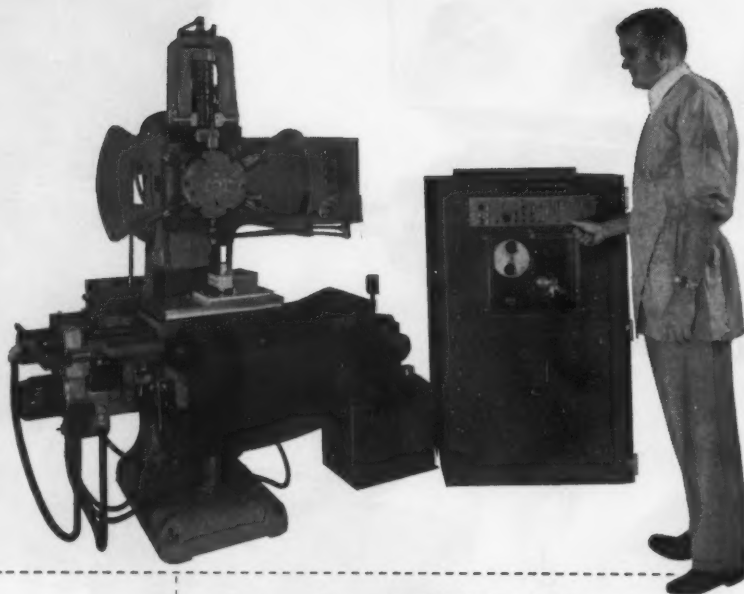
BELOW: Cutaway of part reveals quality finish of Bor-Drilled hole.



BOTTOM: Equipped for Bor-Drill operation, Style 112-O Precision Boring Machine precision-finishes long hole from the solid in 30 seconds.



NEW! HUGHES 2-AXIS MACHINE TOOL CONTROL



The new Hughes Machine Tool Control provides you with automatic positioning of a two-axis table plus third axis feed control if desired. Designed for use in drilling, boring, turning, riveting, spot welding, punching, eyelet inserting and other similar operations, the Hughes Control offers you significant tooling and labor savings. It is easily adaptable to new machines or for retrofit.

*advanced
features of
the new Hughes
Products 2-axis
machine tool
control*

advantages

1. Simplification of tooling reduces lead time.
2. Precision positioning eliminates expensive tooling.
3. Handling is reduced between operations.
4. High-speed operation reduces the number of machines required.
5. Scrap due to operator errors is reduced.
6. Very large savings are realized in re-run of any given parts order.
7. Eliminates large inventories.
8. Rework of tooling after design changes is replaced by simple modification of machine tape.
9. The new operator produces as much as the experienced operator.
10. Cost estimating is more precise.
11. The inspection burden is greatly eased. All parts are identical.
12. Planning and scheduling is greatly simplified. Many more operations can economically be performed with one machine and one setup.
13. Tape control means the machine delivers high precision work at the same cost as low precision work. Tight tolerances at no extra cost.

1. Transistorized circuits.
2. Mercury-wetted relays eliminate "chatter."
3. Positioning accuracy is $\pm 0.0002"$, non-cumulative.
Repeatable accuracy: $\pm 0.0002"$.
Input resolution: $0.001"$.
4. Compact cabinet occupies minimum of valuable floor space.
5. Third axis of control easily added at nominal cost.
6. Electronic position transducer insures continuing accuracy and reliability.
7. Digital system assures positive, accurate, high-speed positioning at 180° per minute.
8. Modular construction of plug-in units cuts down-time. Spare unit simply inserted for continuous production.
9. Standard $1"$, 8-channel Mylar tape used in system.
10. Optical tape reader for precise, high-speed information input.
11. Tape is prepared on Hughes Products unit which is simple to operate and low in cost.

other specifications

Travel	Unlimited, except that the maximum movement per block of tape is 39.999 inches.
Axis Control	Two axes simultaneously.
Drive System	"Creep Traverse Drive Unit" to be attached to preloaded ball bearing leadscrew.
Tape	1 inch, eight channel, opaque, perforated tape.
Tape Reading Time	Less than one second during feed axis movements. Does not add to machining cycle.
Drive System Power	1 1/4 hp (higher power in special unit).
Resolution	0.001 inch.
Auxiliary Functions	24 bits of information available—programmable as six binary coded decimal digits.
Operation Modes	1) Automatic. 2) Set-up (semi-automatic for tape and program checking). 3) Manual.
Power Requirements	110 volt, single phase. Control plus drive motors require less than 10 amps.

*For further information on the Hughes Machine Tool Control...and its application to your specific needs...please write or wire: HUGHES PRODUCTS, Industrial Systems Division, International Airport Station, Los Angeles 45, California.
For export information, write: Hughes International, Culver City, California.*

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SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS

MACHINERY'S DATA SHEET

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—3

Tap Recommendations for Classes 2, 3, *1B, †2B & 3B Unified and American Screw Threads

Fractional Sizes

Size	Threads Per Inch		Recommended Tap For Class of Thread				Pitch Diameter Limits For Class of Thread				
	NC and UNC	NF and UNF	Class 2	Class 3	Class †2B	Class 3B	Min. All Classes (Basic)	Max. Class 2	Max. Class 3	Max. Class 2B	Max. Class 3B
1/4	20	..	G H3	G H2	G H5	G H3	0.2175	0.2211	0.2201	0.2223	0.2211
1/4	..	28	G H2	G H1	G H4	G H2	0.2268	0.2299	0.2290	0.2311	0.2300
5/16	18	..	G H3	G H2	G H5	G H3	0.2764	0.2805	0.2794	0.2817	0.2803
5/16	..	24	G H3	G H1	G H4	G H3	0.2854	0.2887	0.2878	0.2902	0.2890
3/8	16	..	G H3	G H2	G H5	G H3	0.3344	0.3389	0.3376	0.3401	0.3387
3/8	..	24	G H3	G H1	G H4	G H3	0.3479	0.3512	0.3503	0.3528	0.3516
7/16	14	..	G H5	G H3	G H5	G H3	0.3911	0.3960	0.3947	0.3972	0.3957
7/16	..	20	G H3	G H1	G H5	G H3	0.4050	0.4086	0.4076	0.4104	0.4091
1/2	13	..	G H5	G H3	G H5	G H3	0.4500	0.4552	0.4537	0.4565	0.4548
1/2	..	20	G H3	G H1	G H5	G H3	0.4675	0.4711	0.4701	0.4731	0.4717
9/16	12	..	G H5	G H3	G H5	G H3	0.5084	0.5140	0.5124	0.5152	0.5135
9/16	..	18	G H3	G H2	G H5	G H3	0.5264	0.5305	0.5294	0.5323	0.5308
5/8	11	..	G H5	G H3	G H5	G H3	0.5660	0.5719	0.5702	0.5732	0.5714
5/8	..	18	G H3	G H2	G H5	G H3	0.5889	0.5930	0.5919	0.5949	0.5934
3/4	10	..	G H5	G H3	G H5	G H5	0.6850	0.6914	0.6895	0.6927	0.6907
3/4	..	16	G H3	G H2	G H5	G H3	0.7094	0.7139	0.7126	0.7159	0.7143
7/8	9	..	G H6	G H4	G H6	G H4	0.8028	0.8098	0.8077	0.8110	0.8089
7/8	..	14	G H4	G H2	G H6	G H4	0.8286	0.8335	0.8322	0.8356	0.8339
1	8	..	G H6	G H4	G H6	G H4	0.9188	0.9264	0.9242	0.9276	0.9254
1	..	12	G H4	G H2	G H6	G H4	0.9459	0.9515	0.9499	0.9535	0.9516
1	14 NS	..	G H4	G H2	G H6	G H4	0.9536	0.9585	0.9572	0.9609	0.9590
1 1/8	7	..	G H8	G H4	G H8	G H4	1.0322	1.0407	1.0381	1.0416	1.0393
1 1/8	..	12	G H4	G H4	G H6	G H4	1.0709	1.0765	1.0749	1.0787	1.0768
1 1/4	7	..	G H8	G H4	G H8	G H4	1.1572	1.1657	1.1631	1.1668	1.1644
1 1/4	..	12	G H4	G H4	G H6	G H4	1.1959	1.2015	1.1999	1.2039	1.2019
1 3/8	6	..	G H8	G H4	G H8	G H4	1.2667	1.2768	1.2738	1.2771	1.2745
1 3/8	..	12	G H4	G H4	G H6	G H4	1.3209	1.3265	1.3249	1.3291	1.3270
1 1/2	6	..	G H8	G H4	G H8	G H4	1.3917	1.4018	1.3988	1.4022	1.3996
1 1/2	..	12	G H4	G H4	G H6	G H4	1.4459	1.4515	1.4499	1.4542	1.4522

* 1B tapped holes can be produced with CUT thread taps.

† Cut thread taps may be used under normal conditions and in average materials for producing tapped holes to this classification.

The above recommended taps normally produce the Class of Thread indicated in average materials when used with reasonable care. However, if the tap specified does not give a satisfactory gage fit in the work, a choice of some other limit tap will be necessary.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

MACHINERY'S DATA SHEET

AMERICAN STANDARD CUT AND GROUND THREAD TAPS—4

Tap Recommendations for Classes 2, 3, 2B & 3B Unified and American Screw Threads
Numbered Sizes

Size	Threads Per Inch		Recommended Tap For Class of Thread				Pitch Diameter Limits For Class of Thread				
	NC	NF	Class 2	Class 3	Class 2B	Class 3B	Min All Classes (Basic)	Max. Class 2	Max. Class 3	Max. Class 2B	Max. Class 3B
0	..	80	G H1	G H1	G H2	G H1	0.0519	0.0536	0.0532	0.0542	0.0536
1	64	..	G H1	G H1	G H2	G H1	0.0629	0.0648	0.0643	0.0655	0.0648
1	..	72	G H1	G H1	G H2	G H1	0.0640	0.0658	0.0653	0.0665	0.0659
2	56	..	G H1	G H1	G H2	G H1	0.0744	0.0764	0.0759	0.0772	0.0765
2	..	64	G H1	G H1	G H2	G H1	0.0759	0.0778	0.0773	0.0786	0.0779
3	48	..	G H1	G H1	G H2	G H1	0.0855	0.0877	0.0871	0.0885	0.0877
3	..	56	G H1	G H1	G H2	G H1	0.0874	0.0894	0.0889	0.0902	0.0895
4	40	..	G H2	G H1	G H2	G H2	0.0958	0.0982	0.0975	0.0991	0.0982
4	..	48	G H1	G H1	G H2	G H1	0.0985	0.1007	0.1001	0.1016	0.1008
5	40	..	G H2	G H1	G H2	G H2	0.1088	0.1112	0.1105	0.1121	0.1113
5	..	44	G H1	G H1	G H2	G H1	0.1102	0.1125	0.1118	0.1134	0.1126
6	32	..	G H2	G H1	G H3	G H2	0.1177	0.1204	0.1196	0.1214	0.1204
6	..	40	G H2	G H1	G H2	G H2	0.1218	0.1242	0.1235	0.1252	0.1243
8	32	..	G H2	G H1	G H3	G H2	0.1437	0.1464	0.1456	0.1475	0.1465
8	..	36	G H2	G H1	G H2	G H2	0.1460	0.1485	0.1478	0.1496	0.1487
10	24	..	G H3	G H1	G H3	G H3	0.1629	0.1662	0.1653	0.1672	0.1661
10	..	32	G H2	G H1	G H3	G H2	0.1697	0.1724	0.1716	0.1736	0.1726
12	24	..	G H3	G H1	G H3	G H3	0.1889	0.1922	0.1913	0.1933	0.1922
12	..	28	G H3	G H1	G H3	G H3	0.1928	0.1959	0.1950	0.1970	0.1959

† Cut thread taps in sizes 3 — 12 NC and NF inclusive may be used under normal conditions and in average materials for producing tapped holes to this classification.

The above recommended taps normally produce the Class of Thread indicated in average materials when used with reasonable care. However, if the tap specified does not give a satisfactory gage fit in the work, a choice of some other limit tap will be necessary.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

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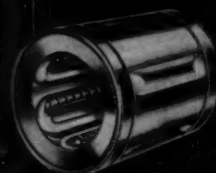
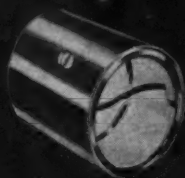
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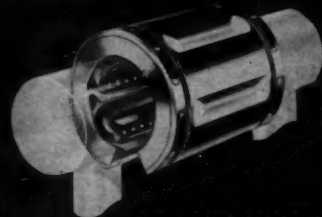
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PROGRESSIVE MANUFACTURERS USE BALL BUSHINGS—A MAJOR IMPROVEMENT AT A MINOR COST

News

OF THE INDUSTRY

California and New Mexico

HUGHES AIRCRAFT Co., Culver City, Calif., announces that three executives have been appointed to managerial positions. DAVID A. HILL was named manager of the semiconductor division of Hughes Products Group. LLOYD H. SCOTT was appointed manager of Santa Barbara Research Center, a Hughes subsidiary. L. JAMES LEVISEE was named director of materiel, general office.



Donald M. McGrath, new vice-president and general manager, Hufford Division, Siegler Corporation

DONALD M. McGRATH has been appointed vice-president and general manager of the HUFFORD DIVISION of the Siegler Corporation, El Segundo, Calif. Mr. McGrath will be responsible for administration, engineering, production, and sales at this division which manufactures specialized machinery and components for the aircraft and missile industries.

GREER HYDRAULICS, INC., is moving its research, development, and production facilities in the fields of missiles, ground support equipment, and hydraulic systems to 5930 W. Jefferson Blvd., Los Angeles, Calif., early in 1960. The company, organized in 1944, has been operating

from a plant at New York International Airport and in Los Angeles.

GISHOLT MACHINE Co., Madison, Wis., announces the appointment of WALTER A. KOWALSKIE to succeed JACK E. CROSE as the direct sales representative for the San Francisco, Calif., territory.

AL MINETTI, who has served as vice-president at HARRON, RICKARD & McCONE Co., has resigned effective January 1, 1960, to form his own distributorship to be known as the MINETTI MACHINERY Co., 1485 Bayshore Blvd., San Francisco, Calif. He will serve the same northern California trade area as all of the other distributors in this end of the state.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, has announced the franchisement of C & E ROTH TOOL & SUPPLY Co., 2007 First St., N. W., Albuquerque, N.M., as an authorized distributor of Parker industrial tube and hose fittings, and Crown compressed air line lubricators, filters, and regulators made by Hannifin Co. division in Des Plaines, Ill. Technical service on fluid-handling circuits will be available as needed from C. Q. HAGERTY, Parker-Hannifin manager of distributor sales in the district which includes New Mexico.

Georgia

J. T. SLOCOMB Co., South Glastonbury, Conn., announces the appointment of JOHN B. LYONS AND ASSOCIATES, 2771 DeLowe Drive, East Point, Ga., as exclusive factory representatives in the southern states. The John B. Lyons organization will be responsible for the appointment and supervision of a group of franchised selected distributors who will stock the J. T. Slocomb line of micrometers to insure efficient sales and service to all industrial concerns in the states of Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas, Tennessee, North Carolina, South Carolina, and Virginia.

PRICE-FLEURY-ARMSTRONG, INC., 1475 Spring St., N. W., Atlanta, Ga., has been named by the CUSHMAN CHUCK Co., Hartford, Conn., as sales representative for the Cushman line of air-operated chucks and cylinders, manually operated chucks, and power wrenches in the states of Virginia, North and South Carolina, eastern Tennessee, Georgia, Alabama, and Florida. H. K. PRICE, president of Price-Fleury-Armstrong, will cover the states of Florida, Georgia, and eastern Tennessee. B. A. FLEURY, vice-president and secretary, will cover Alabama. E. W. ARMSTRONG, vice-president and treasurer, maintains headquarters in Charlotte from where he will cover Virginia, and North and South Carolina.

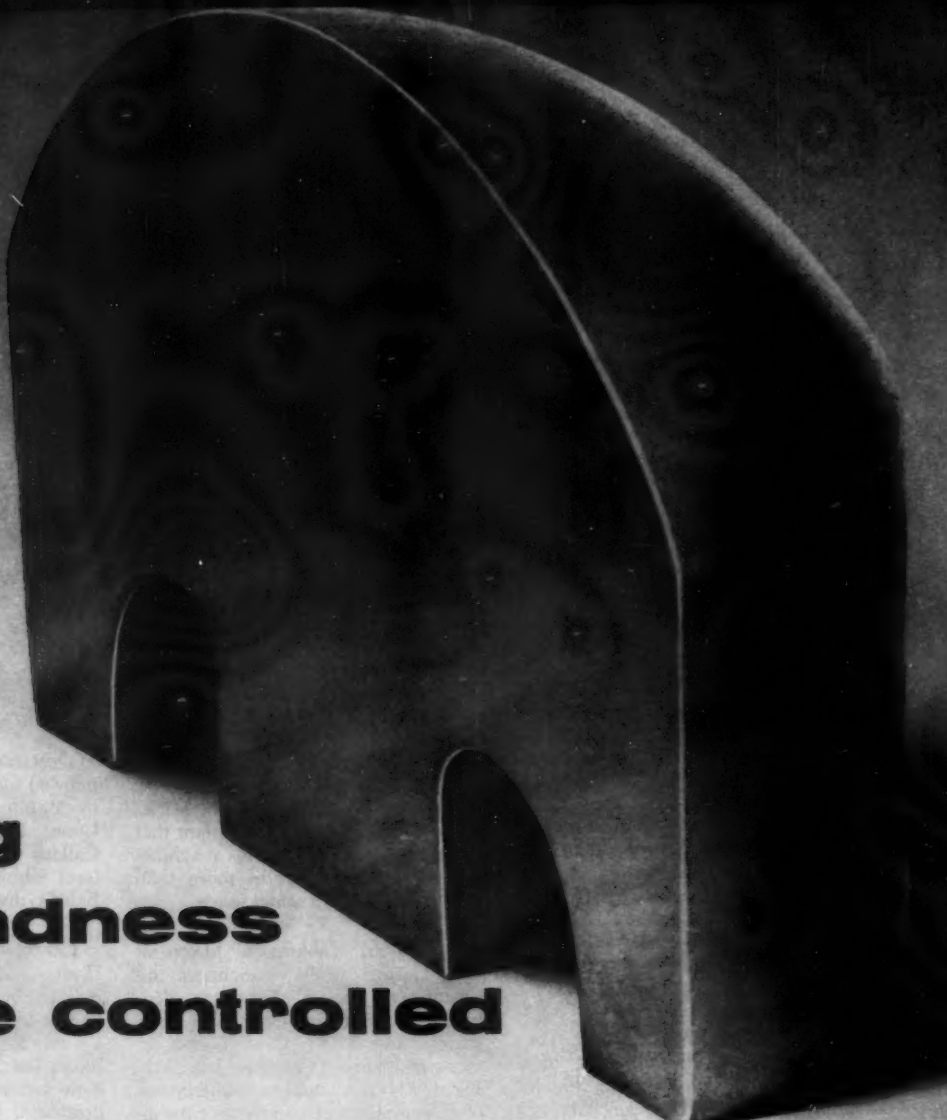
Illinois and Missouri

HANNIFIN Co., Des Plaines, Ill., announces the appointment of H. H. ADAMS, vice-president, as manager of the Power Cylinder Division; A. J. LANSKY as manager of the Valve and Crown Division; and M. E. LAWRENCE, as manager of the Machinery Division.

WHITNEY METAL TOOL Co., 110 Forbes St., Rockford, Ill., announces purchase of the throatless shear and cam press line as manufactured by MARSHALLTOWN MFG. Co. The former will continue the manufacture of this line, offering sales and services from its Rockford office.

EUGENE W. FULLER has been elected executive vice-president of ILLINOIS TOOL WORKS, Chicago, Ill. He was appointed sales manager of the Shakeproof Division in 1938 and general manager of the division in 1954. He was elected vice-president in 1950.

F. JOS. LAMB Co., Detroit, Mich., announces that the company has appointed the DEAN MACHINERY Co., 80 E. Jackson Blvd., Chicago, Ill. as sales representative in the states of Illinois, Iowa, and Wisconsin.



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MEEHANITE METAL

The American Laundry Machinery Co.,
Rochester, N. Y.

Atlas Foundry Co., Detroit, Mich.
Banner Iron Works, St. Louis, Mo.

Barnett Foundry & Machine Co.,
Irvington, N. J.

Casting Service Corp., LaPorte, Indiana
and Bridgman, Michigan

Centrifugally Cast Products Div., The
Shenango Furnace Co., Dover, Ohio

Compton Foundry, Compton, Calif.

Continental Gin Co., Birmingham, Ala.

The Cooper-Bessemer Corp.,
Mt. Vernon, Ohio and Grove City, Pa.

Crawford & Doherty Foundry Co.,
Portland, Ore.

Dayton Casting Co., Dayton, Ohio

Empire Foundry Co., Tulsa, Okla.

and Bonham, Texas
Florence Pipe Foundry & Machine Co.,
Florence, N. J.

Fulton Foundry & Machines Co., Inc.,
Cleveland, Ohio

General Foundry & Mfg. Co., Flint, Mich.
Georgia Iron Works, Augusta, Ga.

Greenlee Foundries, Inc., Chicago, Ill.

Hamilton Foundry, Inc., Hamilton, Ohio

Johnstone Foundries, Inc., Grove City, Pa.

Kanawha Manufacturing Co.,
Charleston, W. Va.

Kennedy Van Saun Mfg. & Eng. Corp.,
Danville, Pa.

Lincoln Foundry Corp., Los Angeles, Calif.

Nordberg Manufacturing Co.,
Milwaukee, Wis. and St. Louis, Mo.

Oil City Iron Works, Corsicana, Texas

Palmyra Foundry Co., Inc., Palmyra, N. J.

The Henry Perkins Co., Bridgewater, Mass.

Pohlman Foundry Co., Inc., Buffalo, N. Y.

Rosedale Foundry & Machine Co.,
Pittsburgh, Pa.

Ross-Meehan Foundries, Chattanooga, Tenn.

Sonith Foundries of FMC, Indianapolis, Ind.

Standard Foundry Co., Worcester, Mass.

The Stearns-Roger Mfg. Co., Denver, Colo.

Vulcan Foundry Co., Oakland, Calif.

Washington Iron Works, Seattle, Wash.

Dorr-Oliver-Long, Ltd., Orillia, Ontario

Hartley Foundry Div., London Concrete

Machinery Co., Ltd., Brantford, Ontario

Otis Elevator Co., Ltd., Hamilton, Ontario

MEEHANITE METAL CORPORATION, NEW ROCHELLE, NEW YORK



(Left) Daniel J. De Carlo, manager, Contract Division, and (right) John Powers, manufacturing manager, Verson Allsteel Press Co.

VERSON ALLSTEEL PRESS Co., Chicago, Ill., has announced the appointment of DANIEL J. DE CARLO to the position of manager, Contract Division. Mr. De Carlo will be responsible for Verson's contract machining and fabricating operations. The company also announces the appointment of JOHN POWERS to the position of manufacturing manager. Mr. Powers has been associated with the company since 1949 as a design engineer and most recently as chief field engineer—hot- and cold-forging equipment.

SCHERR-TUMICO Co., New York City, announces the opening of a new sales office in Chicago, Ill., located at 5045 W. Harrison, Chicago 44. DALE W. FREYBERG will be in charge of this office for the midwest region.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, announces the appointment of STURGIS VALVE & FITTING CORPORATION, 601 S. Taylor Ave., St. Louis 10, Mo., as a distributor for Parker industrial tube fittings and tube-working tools and industrial hose and re-usable Hoze-lok fittings.

Michigan and Wisconsin

MIDLAND-ROSS CORPORATION, Detroit, Mich., announces the appointment of HENRY M. HEYN and EUGENE P. HEILES as vice-presidents of the corporation. Mr. Heyn, as a vice-president of Midland-Ross, will head Surface Combustion—a division of Midland-Ross Corporation. Mr. Heiles, formerly vice-president and

controller of Surface Combustion Corporation, as a vice-president of Midland-Ross will assume the new duties of general manager of Surface's Toledo operation.

F. JOS. LAMB Co., Detroit, Mich., announces expansion of its plant that will more than double machine-assembly area and add more than 25 per cent fabricating space.

NATIONAL BROACH & MACHINE Co., Detroit, Mich., announces the election of BEN F. BREGI as vice-president of manufacturing and research, and T. S. "CAL" GATES as vice-president of engineering. Mr. Bregi, who is a member of the board of directors, was formerly vice-president of engineering. In his new position, he succeeds MAX B. MENTLEY, former vice-president of manufacturing, who is retiring and being

retained by the company as a member of the board of directors and a consultant.

MOTCH & MERRYWEATHER MACHINERY Co., Detroit, Mich., has been appointed sales representative for the OLIVER INSTRUMENT Co., Inc., Adrian, Mich. The company will cover eastern Michigan and northwestern Ohio with sales offices located in Detroit, Flint, Lansing, Toledo, and Tiffin, Ohio.

HARRY L. REYNOLDS has been appointed vice-president and district manager of a new district sales office of the VERNON ALLSTEEL PRESS Co., Chicago, Ill. The office, serving the state of Wisconsin, will be located at 7015 W. North Ave., Wauwatosa 13, Wis.

New England

DONALD CALKINS has been appointed manager of contract services by BAIRD MACHINE Co., Stratford, Conn. In his new position, Mr. Calkins will be in charge of all contract jobbing sales performed under Baird's diversification policy.

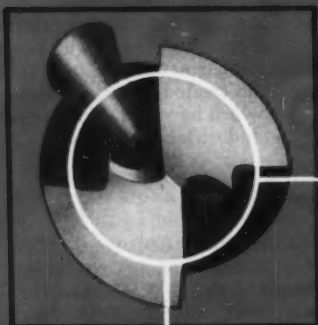
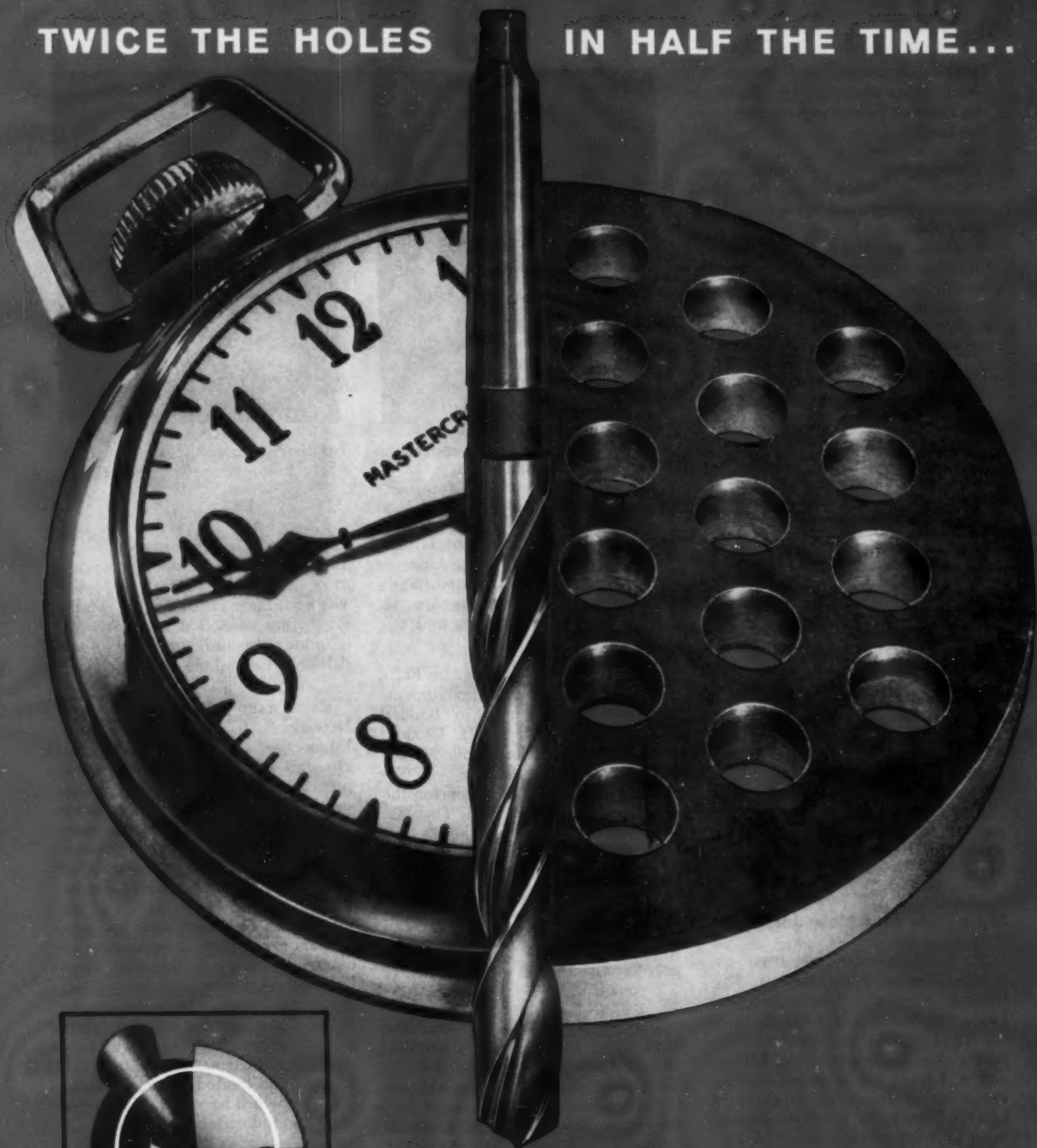
LAPOINTE MACHINE TOOL Co., Hudson, Mass., will sell and service in this country five of Britain's best known lines of machine tools through a newly formed subsidiary which will be called "Lapointe Machine Co." New officers of the subsidiary are: president, JOHN J. PRINDIVILLE, JR.; executive vice-president, EDWARD M. DOWD; vice-presidents, JOSEPH P. CROSBY, CHARLES T. PARKIN, and JACQUES A. PRINDIVILLE; CHARLES J.



(Left) Ben F. Bregi, vice-president—manufacturing and research, and (right) T. S. Gates, vice-president—engineering, National Broach & Machine Co.

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the drill with the patented rib that permits 50% to 400% higher feed rates, cuts production time and costs.

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HELLEN, treasurer; and JAMES W. DOPP, sales manager. Mr. Parkin is the resident liaison representative in England.

SERVOCONTROL, a division of the Oilgear Co., Milwaukee, Wis., has recently transferred operations to a new plant at 160 Bear Hill Rd., Waltham 54, Mass. Complete electrohydraulic systems can be designed, built, and tested in this plant. Managing Servocontrol is THOMAS R. PORTER. The chief engineer of the division is J. WESLEY BROOME.

NORMAN C. DRECHSEL has been appointed manager of NIAGARA MACHINE & TOOL WORKS' Boston, Mass., district office. The office, located at 500 Main St., Waltham, Mass., serves sheet and plate metalworking industries in Massachusetts, Vermont, New Hampshire, Maine, and Rhode Island.

CHANDLER & FARQUHAR Co., INC., 900 Commonwealth Ave., Boston, Mass., has been appointed an authorized distributor of Carboloy cemented-carbide products by the METALLURGICAL PRODUCTS DEPARTMENT, General Electric Co., Detroit, Mich. The firm will serve the Massachusetts counties of Plymouth, Middlesex, Bristol, Essex, Norfolk, and Suffolk.

NORMAN P. JOHNSON has been appointed assistant chief industrial engineer for NORTON Co., Worcester, Mass.

New York and New Jersey

T. F. O'CONNELL has been appointed general sales manager, Distributor Products Department of LINDE COMPANY, a division of Union Carbide Corporation, New York City. In his new assignment, Mr. O'Connell will have full responsibility for execution of the sales program of Linde's Distributor Products Department and for administration of Distributor Products Region Sales Offices. Mr. O'Connell is expected to assume his new duties, with headquarters in New York, early in 1960.

SENECA FALLS MACHINE Co., Seneca Falls, N. Y., has announced that beginning October 1, 1959, its line of automatic tracer and multiple-tool lathes, as well as automatic centering machines and electronic equipment, will be sold in central and western New York by ROBERT JONES. Mr. Jones will continue to make his headquarters in Seneca Falls.



W. T. Alderson, vice-president, Ingersoll-Rand Co.

W. T. ALDERSON has been elected vice-president of INGERSOLL-RAND Co., New York City. Mr. Alderson will be located in Ingersoll-Rand's New York executive offices. Mr. Alderson joined the company in 1927.

CARBORUNDUM Co., Niagara Falls, N. Y., announces three appointments in the sales branch of its Bonded Abrasives Division. D. H. CURRIE, product manager for vitrified products-metallic applications, is appointed field sales engineer for the Buffalo sales district. P. R. THOMAS, field sales engineer for the Detroit sales district, is appointed product manager for vitrified products-metallic applications. A. E. BENNETT, assistant product manager of resinoid products for metallic applications, is appointed field sales engineer for the Detroit sales district.

AMERICAN BRAKE SHOE Co., New York City, announced the acquisition of RAYMOND ATCHLEY, INC., a West Coast manufacturer of electrohydraulic and electropneumatic servocontrols. Products of the acquired company will complement Brake Shoe's lines of hydraulic equipment. The Atchley firm will be operated as a wholly owned subsidiary. RAYMOND D. ATCHLEY will continue as president.

STANLEY T. BOWDEN has been appointed sales manager of the WATSON-STILLMAN PRESS DIVISION, the Farrel-Birmingham Co., Rochester, N. Y. He will direct the sale of Farrel Watson-Stillman hydraulic machinery for the plastics, metalworking, extrusion, and general industries.



Francis P. Iapalucci, plant manager, Lake Erie Machinery Corporation

FRANCIS P. IAPALUCCI has been appointed plant manager of the LAKE ERIE MACHINERY CORPORATION, Buffalo, N. Y. He is at present vice-chairman of the Filler Metals Committee of ASTM and AWS and is industrial coordinator of the main Advisory Committee for Ordnance.

ENGELHARD INDUSTRIES, INC., Newark, N. J., announces the establishment of an Industrial Diamond Division which will import, stock, process, and sell industrial diamonds in the United States and provide technical service, application engineering, and basic research for users. There will be a substantial stock of industrial diamonds available domestically. As soon as the needs of the market can be ascertained, the new division will supply specific sizes of diamond grit. Up to this time, most users of diamonds have bought ungraded material, which necessarily included grit sizes not suited for their particular use. Engelhard will supply both regular natural grit and the selected and treated types of natural diamond which have proved superior in certain industrial applications.

Ohio

J. T. SLOCOMB Co., South Glastonbury, Conn., announces the appointment of the R. A. HELLER Co., 6509 Vine St., Cincinnati 16, Ohio, as a selected distributor of its line of micrometers and industrial measuring instruments.

SURFACE COMBUSTION, a division of Midland-Ross Corporation, Toledo, Ohio, announces a number of changes in its heat-treat field sales organization. L. I. SIELOFF, formerly

with the Detroit district office, moved to the Indianapolis office; W. M. DEMPSTER, sales engineer in the Syracuse office, moved to the Detroit office; T. T. PHIPPS from the Cleveland office moved to the Syracuse office; G. F. WILLHAUCK from the Toledo Sales Department moved to the Cleveland Office.



Kermit Kuck, executive vice-president, Monarch Machine Tool Co.

KERMIT KUCK has been appointed executive vice-president of the MONARCH MACHINE TOOL CO., Sidney, Ohio. Mr. Kuck has been with the company twenty-four years, starting in the shop and moving on into engineering and sales. Added responsibilities came with his appointment in 1947 as vice-president, engineering.

DELCO MORaine DIVISION, General Motors Corporation, Dayton, Ohio, has changed its name from "Moraine Products Division" effective December 31, 1959. Delco Moraine products include automotive and power brakes, engine bearings, and sintered metal parts, many of which are sold under the trademark "Delco."

CLEVELAND TRAMRAIL DIVISION of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, announces that JAMES TURK has been appointed Midwest district sales manager. Mr. Turk succeeds WILLIAM P. HANKS, who has retired after thirty-three years with the company.

PAUL MINARIK CO., 3100 Wooster Road, Rocky River, Ohio, has been appointed sales representative in northern Ohio for RUSSELL, BURDSALL & WARD BOLT and NUT CO., Port Chester, N. Y. The firm will cover the area bordering Lake Erie

between Toledo and the Pennsylvania border.

B. E. STORRS has been appointed to the post of service engineer with the East-Central District staff of the METALLURGICAL PRODUCTS DEPARTMENT of General Electric Co., in Cleveland, Ohio.

KENNETH I. MIELKE has been appointed sales representative of the MUELLER BRASS CO., Port Huron, Mich. He has been assigned to the Cincinnati, Ohio, office.

Pennsylvania and District of Columbia

MORSE TWIST DRILL & MACHINE Co., New Bedford, Mass., announces that ELMER C. STACKS was appointed district manager in the Baltimore, Virginia, and eastern Pennsylvania areas for the firm, a division of Van Norman Industries, Inc. His headquarters will be in Philadelphia. Mr. Stacks will be assisted by JOSEPH A. DONNELLY, who will serve as a Morse salesman in the eastern Pennsylvania area.

EDWARD D. JAMES has been named regional manager of the newly combined Philadelphia and metropolitan New York sales territories of the WILTON TOOL MFG. CO., Inc., Schiller Park, Ill. The new territory will comprise the two cities plus eastern Pennsylvania, Maryland, Virginia, Delaware, and the northern half of New Jersey. Mr. James will continue to reside at 470 Howellville Rd., Berwyn, Pa., a suburb of Philadelphia.

EDWIN S. PHILLIPS, president of the N. S. PHILLIPS CO., 913 Penn Ave., Pittsburgh, Pa., has been named sales and service representative of the N. A. WOODWORTH CO., Detroit, Mich. The Phillips organization will service the southwestern Pennsylvania and West Virginia area.

EDWARD R. KROBERGER has been appointed sales engineer for the BUTTERFIELD DIVISION, Union Twist Drill Co., Derby Line, Vt. Mr. Kroberger will cover southern New Jersey and the Philadelphia area with headquarters in Oreland, Pa.

ROCKWELL MFG. Co.'s Delta Power Tool Division, Pittsburgh, Pa., announces that WILLIAM W. MARSHALL and JOHN CADIGAN have been named district sales managers in the

Eastern and East-Central regions respectively.

HENRY G. MAGNUSSEN, for many years an official of the LINDBERG ENGINEERING CO., and the LINDBERG STEEL TREATING CO., Chicago, Ill., was named advisor to NIELS A. OLSEN, director—Metal Working Equipment Division, Business and Defense Services Administration, United States Department of Commerce. Mr. MagnusSEN comes to BDSA under an arrangement by which industry makes available the services of executive personnel for temporary duty without compensation from the Government. The assignment also will qualify him for membership in the National Defense Executive Reserve, which would staff the operation of a production agency in event of national emergency.

Canada

CARMET DIVISION, Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., has announced the opening of a new sales office in Toronto, Ontario, Canada, located at 2489 Bloor St., West, that city. BERT C. CHAPMAN will serve as sales representative for the new office.

Europe

JONES & LAMSON MACHINE CO., Springfield, Vt., U. S. A., announced that it had acquired a substantial interest in the firm LE PROGRES INDUSTRIEL, located in Lot, near Brussels, Belgium. The new company—to be known as Le Progres Industriel-Jones & Lamson Machine Co.—has the exclusive right to manufacture and sell in the European common market the current line of products made by Jones & Lamson in the United States.

FAFNIR BEARING CO., New Britain, Conn., and the TIMKEN ROLLER BEARING CO., Canton, Ohio, announced today that they will shortly conclude an agreement by which Fafnir will purchase all the assets and business of the FISCHER BEARINGS CO., LTD., one of Timken's British subsidiaries. Fischer, until recently owned by the former British Timken Ltd., is the fourth largest bearing manufacturer in England.

JOHN LANG & SONS LTD., machine tool makers of Johnstone, Renfrewshire, Scotland, and the GISHOLT MACHINE CO., Madison, Wis.,

U. S. A., announce the formation of a joint manufacturing company to be called Lang Gisholt Machine Co. Ltd. This company will occupy the existing John Lang & Sons Ltd., factory at Johnstone near Glasgow. Directors of the new joint company will be: GEORGE H. JOHNSON, chairman (president of Gisholt Machine Co., Madison, Wis.), J. T. LANG, managing director, COMMANDER J. H. M. G. LANG, R. N. (Retd.), J. S. LANG, H. S. JOHNSON II, and CARL W. HAYDEN. Lang Gisholt Machine Co., Ltd. will immediately manufacture the complete Lang range of lathes and power-operated chucks for John Lang & Sons Ltd., who will continue to be represented at home and overseas by Associated British Machine Tool Makers Ltd. They will also continue the present Lang gear cutting for the trade.

Obituaries

HOWARD L. MCGREGOR, board chairman of the National Twist Drill & Tool Co., Rochester, Mich., died November 12, 1959, at the age of seventy-two. Mr. McGregor became president of National Twist Drill in 1926 and chairman of the board in 1936. He was instrumental in forming the Metal Cutting Institute of which he served as chairman of the board for a number of years. In addition, he was a member of the Iron and Steel Institute. Mr. McGregor was a benefactor and philanthropist, especially interested in the advance of medicine. He established the William H. McGregor professorial chair in the Wayne State University College of Medicine. He was active in many community organizations and clubs.

PATRICK J. GIBBONS, executive vice-president of Vanadium Corporation of America, New York City, until his retirement in 1952, died on November 28, 1959. He was sixty-nine. Mr. Gibbons had been with VCA for forty-two years, twenty-seven of them as an officer or director. After his retirement, he continued as a consultant to the president.

RALPH P. GARRISON, president of Garrison Machine Works Inc., Dayton, Ohio, died on November 15, 1959. Mr. Garrison had been associated with the company for twenty-nine years and as president for the past fourteen years.

New Books and Publications

AUTOMATING THE MANUFACTURING PROCESS. By George F. Hawley, 147 pages; 63 illustrations; 6 by 9 inches. Reinhold Publishing Corporation. Available from THE INDUSTRIAL PRESS, 93 Worth St., New York 13, N. Y. Price, \$4.95 postpaid.

This book should appeal primarily to executives, production managers, engineers, and anyone else who is considering automating the whole or any part of his production process.

The author presents in practical terms some of the mechanical problems involved in inventing and designing machinery for specific operations such as assembling components and packaging of individual products. He also spells out some of the pitfalls involved in automating a process and discusses in broad detail the roles of the inventor, designer, engineer, and others involved.

The table of contents of this book is a good indication of the successive steps involved in the automation process: Automation—a State of Mind; Economic Feasibility; How to Get Started; First Steps into a Specific Project; What Kind of Machine Do You Want?; Invention; Building a Model; Engineering; Design; the Design Phase of a Specific Project; Building the Automatic Machine; Debugging; and The Run-in Period.

MACHINABILITY MANUAL NUMBER ONE FOR TURNING-FACING-BORING OPERATIONS. By John A. Hedrick. 50 pages; illustrated; 8 1/2 by 11 inches. Published by the Author, Box 143, Parkersford, Pa. Price, \$15, including tax.

This manual attempts a new approach to provide technical information in a simplified form to anyone involved in the computation of metal-removal problems. It will be found valuable by the machine tool engineer, estimators, and process engineers, as well as shop supervisors, machinists, and apprentice and vocational students of the trade. The major contents consist of two vinylite-plastic, dial type instruments. One instrument is a Machinability Selector which provides average speeds and feeds for various conditions of setup rigidity. This information is provided separately for tungsten-carbide tools and separately for HSS cutting tools. The other is a Machining Calculator which is

used to compute the information provided by the Selector to arrive at cut time and pieces per hour. Included as part of this Manual are material data sheets, work sheets, and a set of instructions to provide a simplified standards system.

LUBRICATION OF BEARINGS—THEORETICAL PRINCIPLES AND DESIGN. By E. I. Radzimovsky, Dr. Tech. Sci. 338 pages; 6 by 9 1/4 inches; 116 illustrations. Published by the Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price, \$10.

This is the first book on the subject specifically designed as a textbook. It presents a concise treatment of the theoretical principles and design considerations involved in the lubrication of bearings. The purpose of this textbook is to impart a clear understanding of bearing operation, and to develop the ability to analyze bearings and to apply this analysis to engineering problems. Major stress is given hydrodynamic theory, but the practical aspects of bearing design, materials, and the thermal equilibrium of bearings are thoroughly treated. Throughout, examples and problems demonstrate application of theory. Numerous graphs and illustrations are supplied.

Coming Events

APRIL 21-28—ASTE Tool Show will be held at Detroit Artillery Armory, Detroit, Mich. For additional information write to Leonard Abrams, Exposition Manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.

APRIL 25-26—ASME Maintenance and Plant Engineering Conference will be held at the Chase-Park Plaza Hotel, St. Louis, Mo. For additional information, write to L. S. Denegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

APRIL 25-29—ASME Metals Engineering Division—AWS Conference will be held at the Biltmore Hotel, Los Angeles, Calif. For further information: L. S. Denegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

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Some of our customers are hardboiled characters who cut their teeth on blue chips and were weaned on cutting oil. No kidding, they are really down to earth. Yet they have told us that the Famco mill is the finest mill they have ever used.

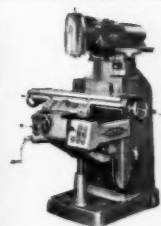
Naturally, they have an easy time convincing us. We build them. But how can you be convinced?

We would like your opinion! Write for the brochure describing these machines or ask for the address of your nearest dealer. We'll be happy to oblige. In that way, you can judge Famco's milling machine superiority for yourself.

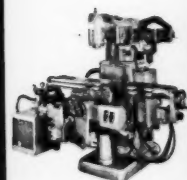


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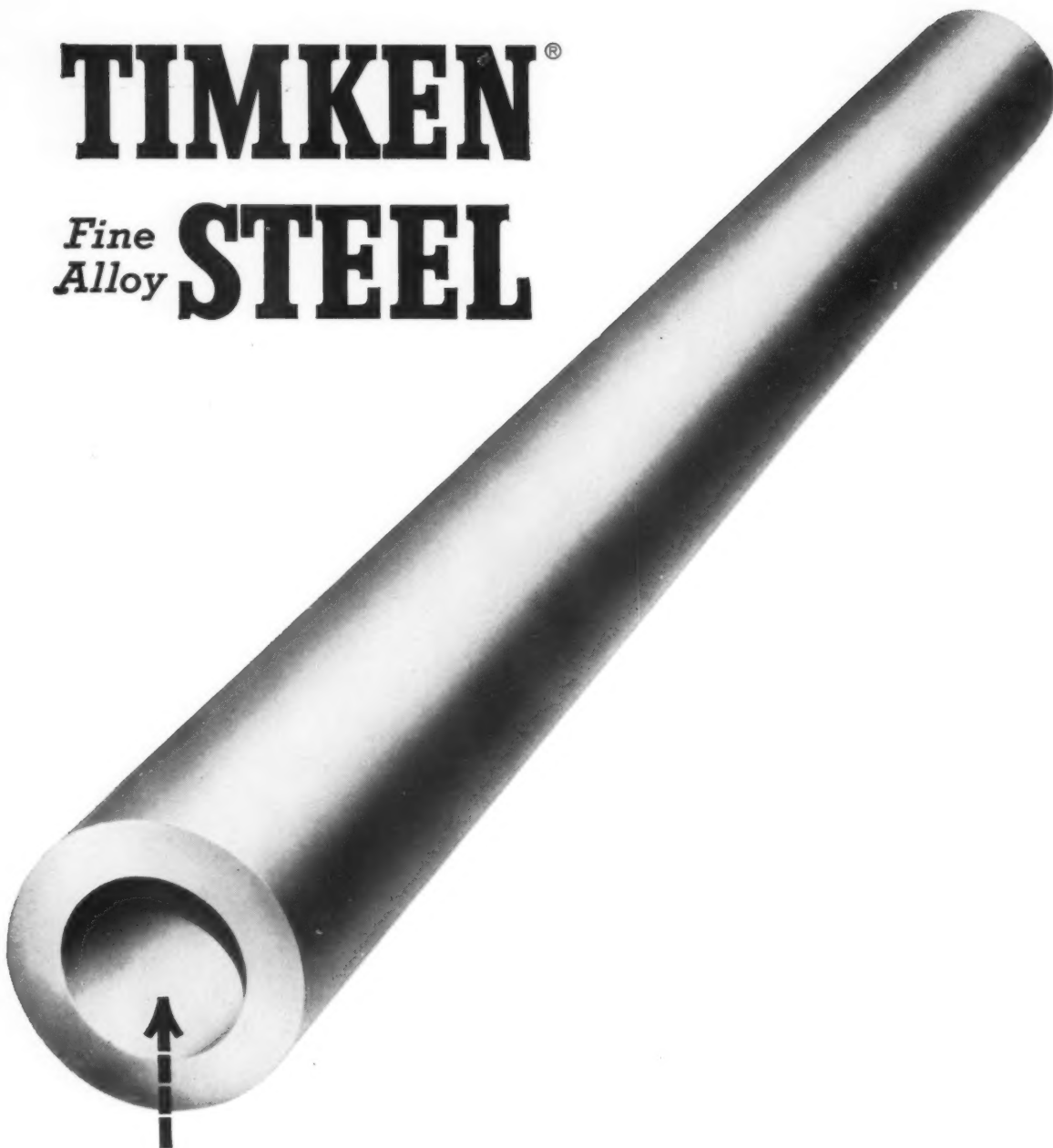
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When you buy Timken steel you always get:

1) *Quality* that's uniform from heat to heat, tube to tube, order to order; 2) *Service* from the experts in specialty steels; 3) Over 40 years of *experience* in solving tough steel problems. Let our engineers help you save by recommending the most economical tube size for your hollow parts job . . . one guaranteed to clean up to your finish dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

TIMKEN ALLOY STEEL AND SEAMLESS STEEL TUBING ARE AVAILABLE FROM WAREHOUSE STOCKS IN 44 CITIES IN THE UNITED STATES



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Stuart's **SOLVOL** liquid cutting compound



You may not be using soluble oils for "big chip" machining. But there is a super-lubricity compound—Stuart's Solvol—designed specifically for these jobs. A cutting fluid more and more of America's top companies are using for broaching, milling, and heavy-duty turret lathe work.

Compounded of a high-lubricity fatty oil, petroleum base, and a heavy-duty emulsifier, Solvol gives you the right combination of lubricity and cooling action for economical tool life at efficient machine speeds. Here's why . . .

Extremely fine particles of fatty oil are suspended in water like millions of delicate organisms under the sea. Fatty oil

that comes from the sea—the best fat for lubricity money can buy. Solvol's high concentration of sperm oil allows chips to slide over the tool face without high friction and heat build-up. Stops chip welding and tool breakdown.

You get all these advantages in a water-mix compound that cools faster, eliminates smoke, handles a wide range of cutting operations at the lowest possible tool lubrication cost.

So, when you make the switch from straight oils to a water-mix cutting fluid, don't sacrifice lubricity. Because Solvol combines both—the cooling capacity of water, with the extra lubricity you need for economical machining.





low friction · high finish

Stuart's **CODOL**

liquid grinding compound



Grinding experts will tell you there's only one way to get a slick surface finish without going to extremely fine grit wheels or a straight grinding oil—and you don't have to give up wheel life or cooling action to get it.

That is by utilizing the balanced lubricating and scrubbing action of a water-mix like Stuart's Codol liquid grinding compound. For Codol's balanced formula provides the high surface finish advan-

tages of a straight oil . . . in colloidal form . . . plus the cooling capacity of water.

Extremely fine oil particle size results in a near-transparent solution. Codol is not an opaque emulsion like most soluble oils . . . yet, it has none of the machine maintenance disadvantages of transparent compounds.

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STANDARD BASE available in single solenoid, 3-way; single solenoid, 4-way; double solenoid, 4-way.

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Schrader's complete line of air valves allow you a freer hand in planning air circuits for your applications. Besides almost unlimited choice of size, style and actuation method, you get these extras in every Schrader valve you buy:

- All parts are designed for maximum air flow, longest service life; simplicity of replacement; interchangeability.
- Schrader Valves feature tough, practical design, precision construction, and are individually tested to full ratings.

- Performance has been proved by years of use in hundreds of plants. All Schrader Valves can operate with Schrader (JIC) Square End Cylinders perfectly.

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Product Directory

To find headings easily, look for capital letters at top of each page to denote location.

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Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.

Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.

ABRASIVES, Disc

Delta Power Tool Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester, Mass.

ABRASIVES, Polishing, Tumbling, Etc.

Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Macklin Co., Jackson, Mich.

ACCUMULATORS, Hydraulic

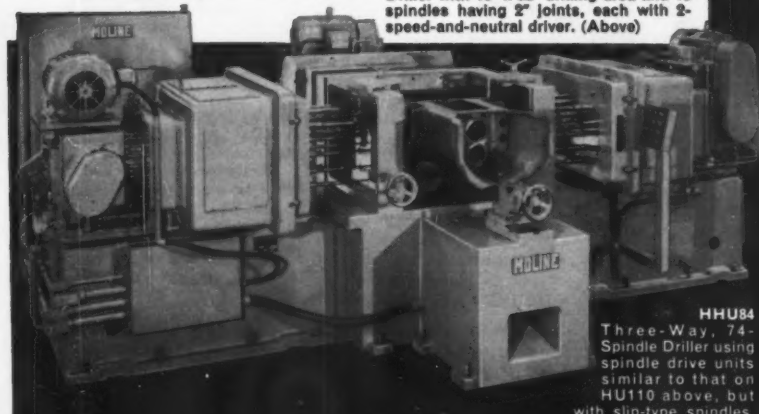
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.



Use rugged, reliable "Hole Hog" machine tools for such jobs as:

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HU110
Universal Joint Type Driller with 18" x 32" drilling area and 16 spindles having 2" joints, each with 2-speed-and-neutral driver. (Above)



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Three-Way, 74-Spindle Driller using spindle drive units similar to that on HU110 above, but with slip-type spindles.

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AIR GUNS

Chicago Pneumatic Tool Co., New York, 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Tool Steel Co., Chicago Hts., Ill.
Jessop Steel Co., Washington, Penna.
Ryerson, Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave., Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing

Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Mueller Brass Co., Port Huron, Mich.

ALUMINUM and Aluminum Products

Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

ANGLE PLATES—See Set-up Equipment

ANNEALING FURNACES

Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.
General Electric Co., Schenectady 5, N. Y.

ARBOR PRESSES—See Presses Arbor

ARBORS AND MANDRELS

Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill. (end mills)
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mich. Co., Inc., Logansport, Ind.



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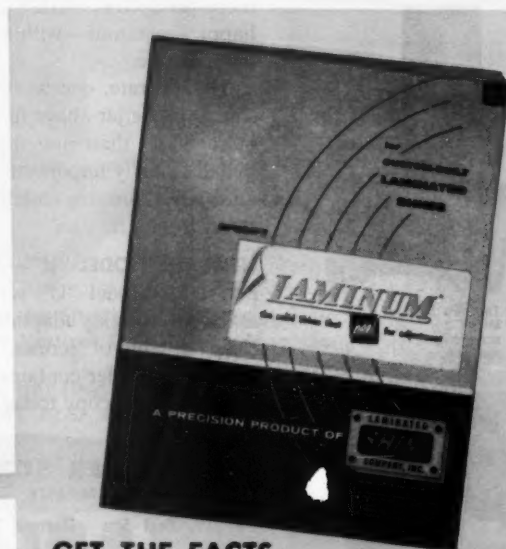
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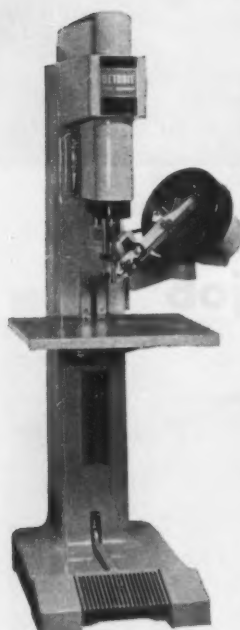
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NEW! THE MODEL "U"—At left, meet the great, new DPS Model "U" screwdriving machine—quickly adaptable for fast, clean driving of screws, nuts and studs. New folder contains full data. Write for your copy today.

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Sheffield Corp., Box 893, Dayton 1, Ohio

AUTOMATIC SCREW MACHINES—See Screw Machines, Single and Multiple-Spindle Automatic

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Casa Corp., 405 Lexington Ave., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sunstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALLS

Hoover Ball & Bearing Co., Ann Arbor, Mich.
Kennametal, Inc., Latrobe, Penna.

BAR MACHINES—See Screw Machines, Single and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous

Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Shenango Furnace Co., Dover, Ohio

BAR STOCK AND SHAFING, Steel

Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Jesse Steel Co., Washington, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARING PILLOW BLOCKS AND CARTRIDGES

Fafnir Bearing Co., New Britain, Conn.

BEARINGS, Ball

Ball & Roller Bearing Co., Danbury, Conn.
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
Norma-Hoffman Bearings Corp., Stamford, Conn.
S K F Industries, Inc., Philadelphia, Penna.

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Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio

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Utilizes
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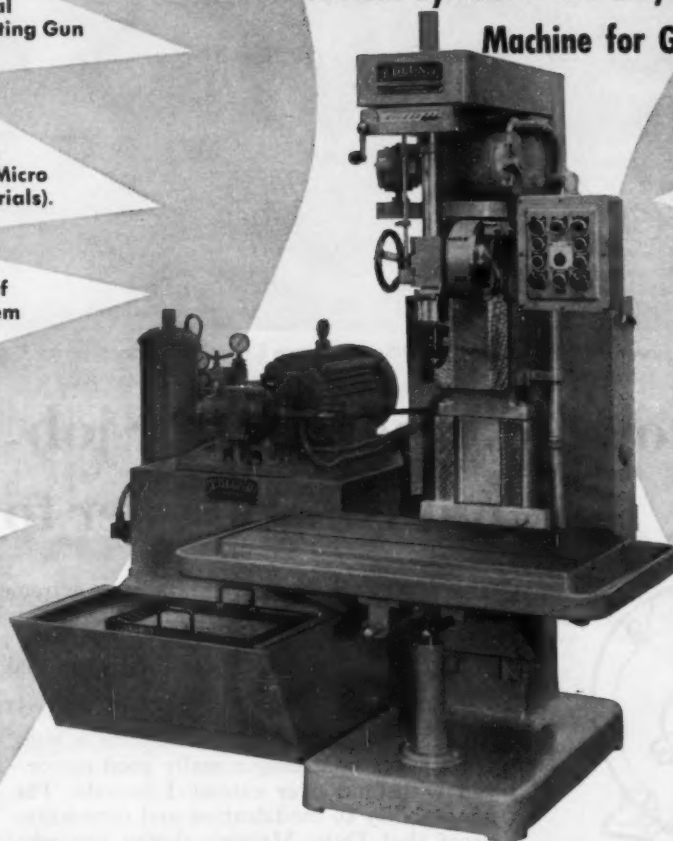
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Fine Finish (2 to 32 Micro
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Easy Drilling of
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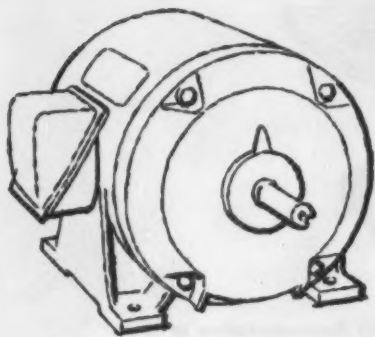
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Division of Harco Corporation



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"This a-c. motor stands up to the more extreme forms of industrial abuse . . . electrically and mechanically. It meets rugged duty cycles because of *built-in protection* . . . plus Reliance's ability to engineer the motor to any unusual application.

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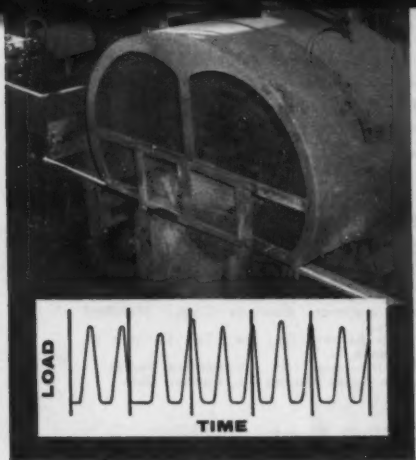
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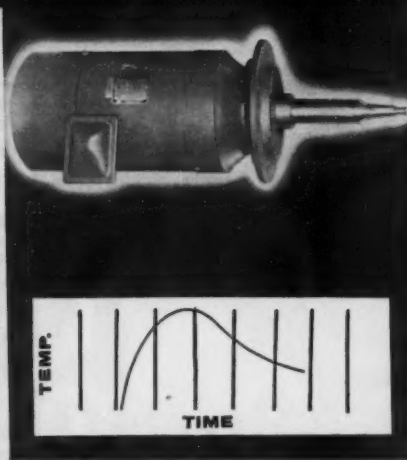
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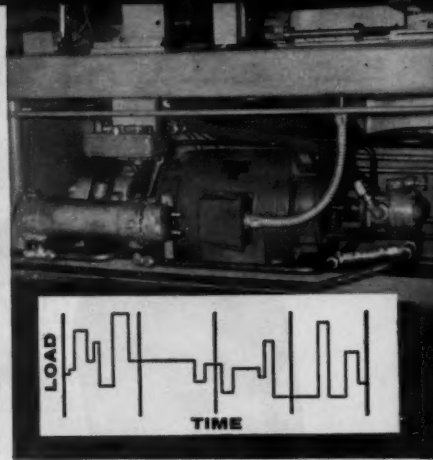
Duty Master
A-C. MOTOR



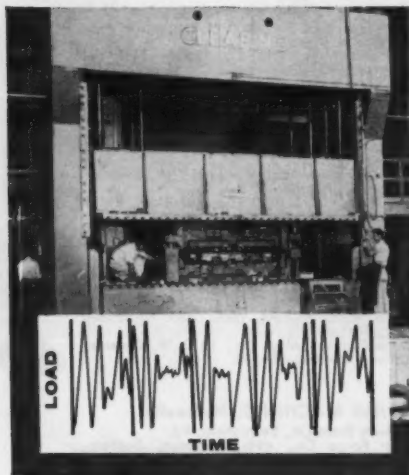
Hot Saw Motor: Duty Master powers a saw cutting 40 foot lengths of red-hot 4" diameter tubular steel moving at speeds up to 2000 feet per minute. Tremendous gyroscopic loads are exerted on bearings and rotating assembly by a rapidly circling saw arm. The motor is equipped with extra strength bearings, as well as a special oil mist lubrication system, in order to maintain continuous resistance to unusual operating pressures.



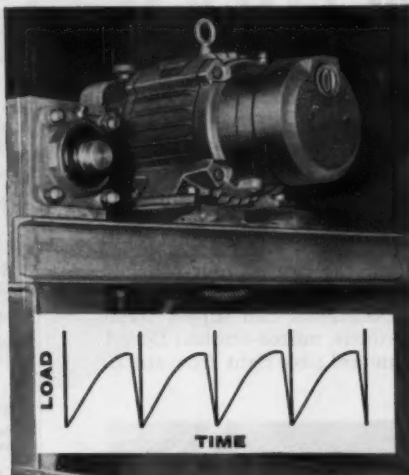
Furnace Fan Motor: Placed outside an annealing furnace, Duty Master uses a bi-metal shaft in driving fan inside. Bi-metal properties of the shaft reduce 2000°F. furnace temperature to bearing temperature. Special motor cooling design takes care of shaft expansion, supplies sufficient cooling to protect bearing adjacent to the furnace. Motor takes high overloads at the start due to low temperature air present as furnace begins operation.



Hydraulic Pump Motor: Injection molding machine shown is operated by a Duty Master close-coupled, double-end assembly. Necessary 25 hp. rating installed in limited space was accomplished using Class F insulation which permitted smaller frame size. Thus, this converted standard stock motor does the necessary job in a space which prohibited foot mounted pumps. Actually the unit cost is lower with this new application.



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The basic advantages of Duty Master stem from its sound design and engineering . . . from the inside out. Regardless of the ways in which you use this motor, Duty Master *will perform* . . . to your satisfaction.

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18-1841

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Reliance Electric and
Engineering Company and its
Master and Reeves Divisions

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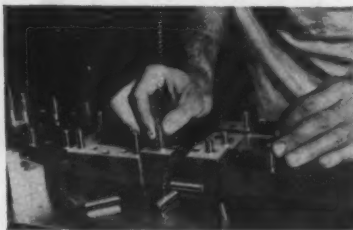


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Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Norma-Hoffman Bearings Corp., Stamford, Conn.
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S. K. F. Industries, Inc., Philadelphia, Penna.
Timken Roller Bearing Co., Canton, Ohio

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Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
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Railway Bearing Co., Inc., Syracuse, N. Y.
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MACHINERY, January, 1960

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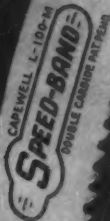


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Universal Engineering Co., Frankenthuth 2, Mich.
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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
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New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

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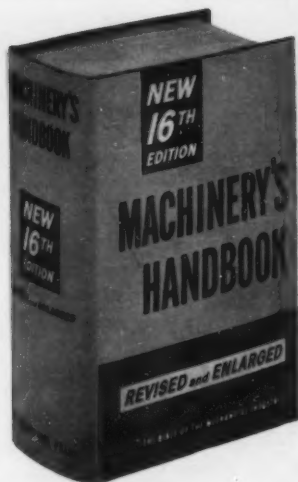
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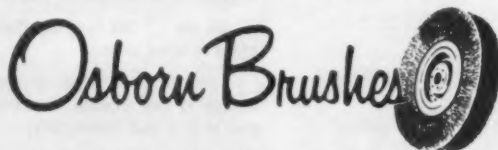
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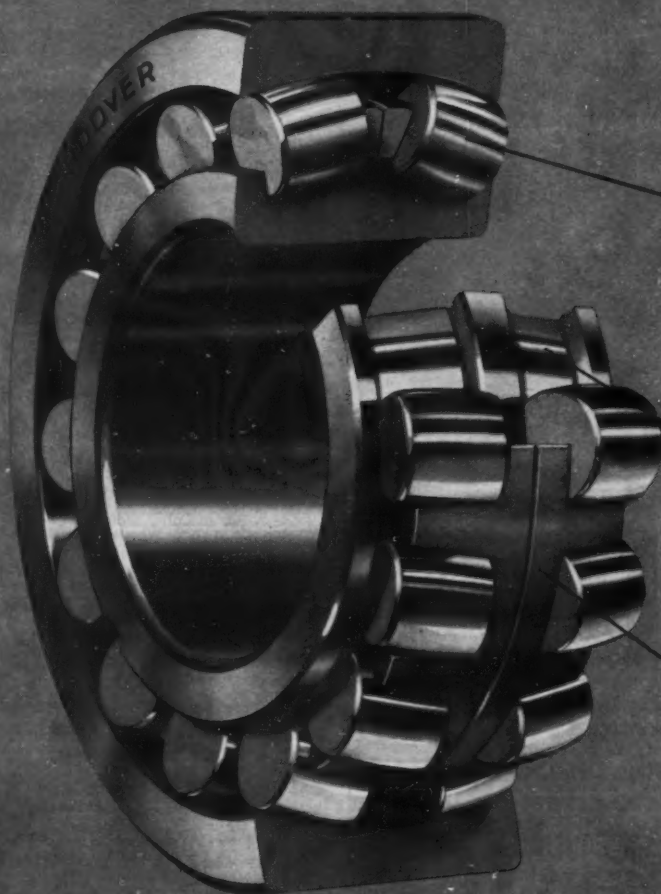
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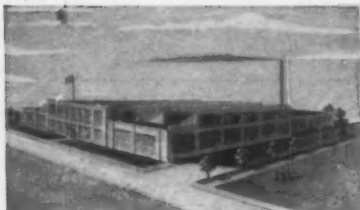
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Van Norman Machine Co., 3640 Main St.,
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CAMERAS, High Speed

Wollensak Optical Co., Rochester 21, N. Y.

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burgh 22, Pa.
Baird Machine Co., 1700 Stratford Ave., Strat-
ford, Conn.
Landis Tool Co., Waynesboro, Pa.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3,
N. J.
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Kennametal, Inc., Latrobe, Penna.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio
Metallurgical Products Dept. of General Elec-
tric Co., Box 237, Roosevelt Park Annex,
Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd.,
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Madison-Kipp Corp., Madison, Wis.

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lehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Shenango Furnace Co., Dover, Ohio
Textile Machine Works, Reading, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable

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lehem, Pa.
Hill Acme Co., 1201 W. 65 St., Cleveland 2,
Ohio
Kaukauna Machine & Foundry Div., Giddings
& Lewis Machine Tool Co., Kaukauna, Wis.
Malleable Castings Council, 781 Union Com-
merce Bldg., Cleveland 14, Ohio
Mechanite Metal Corp., New Rochelle, N. Y.
Shenango Furnace Co., Dover, Ohio
Sundstrand Mch. Tool Co., 2531 11th St.,
Rockford, Ill.
Textile Machine Works, Reading, Penna.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Beth-
lehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
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CEMENT, Abrasive Disc

Delta Power Tool Div., 400 N. Lexington Ave.,
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CENTER-DRILLING MACHINES

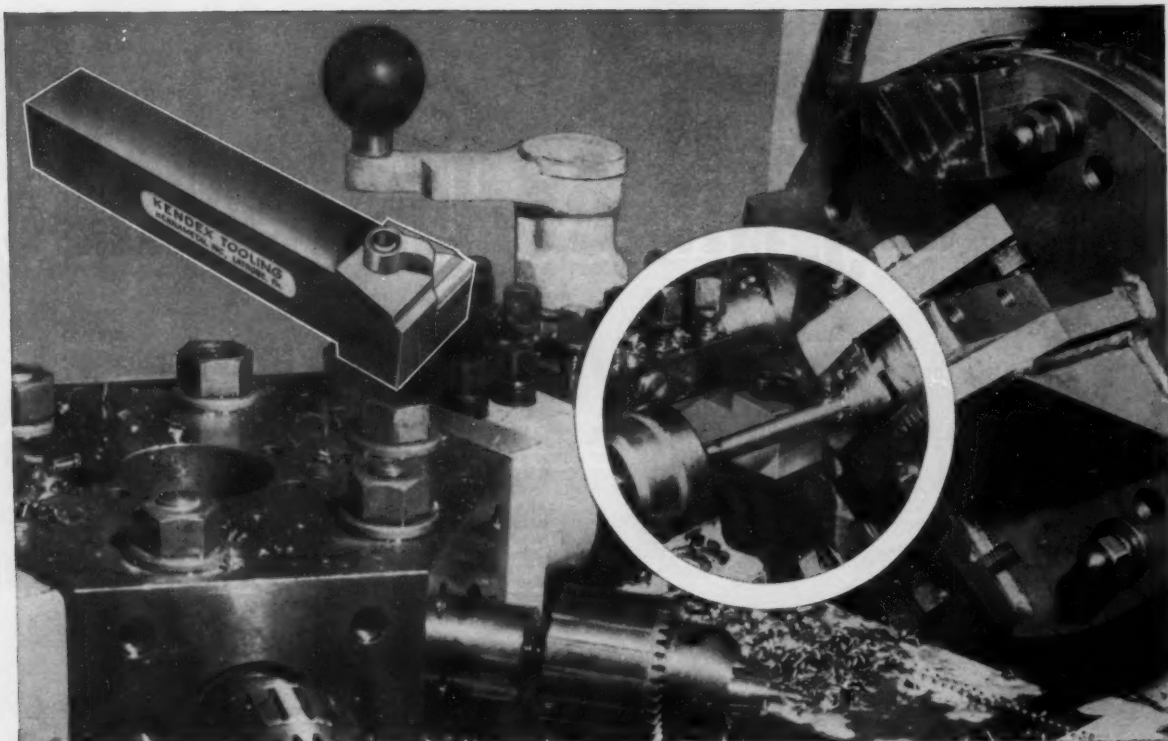
Baker Brothers Inc., 1000 Post Ave., Toledo
10, Ohio
Sundstrand Mch. Tool Co., 2531 11th St.,
Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe

DoAll Co., Des Plaines, Ill.

(Continued on page 232)



Support bracket for Nike-Hercules guided missile, being machined with Kendex* (patented) tooling from a 316 stainless forging. Photo and performance data supplied by a leading aircraft manufacturer.

If you could cut machining cost/piece 78% wouldn't you switch to KENDEX?

That's what happened here

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When one lathe was equipped with Kendex (patented) tooling and Kennametal* K8 inserts to utilize maximum output capability of the machine, production was increased fivefold and enough parts were produced by this one machine in 8 hours to keep the line running. The second lathe was released for other work.

While tooling cost per hour increased over 500%, the machining cost per piece dropped from \$3.08 to 68 cents. By sacrificing a few pennies in higher tool costs, many dollars are being saved in over-all machining costs.

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97288

Don't waste dollars  in machine output
to save pennies in tool life 

	640-minute tool life	125-minute tool life
Machine cost per hour	\$ 6.00	\$ 6.00
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Combined cost—8 hours	\$49.28	\$54.88
Pieces produced—8 hours	16	80
COST PER PIECE	\$ 3.08	\$.68



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TEXAS

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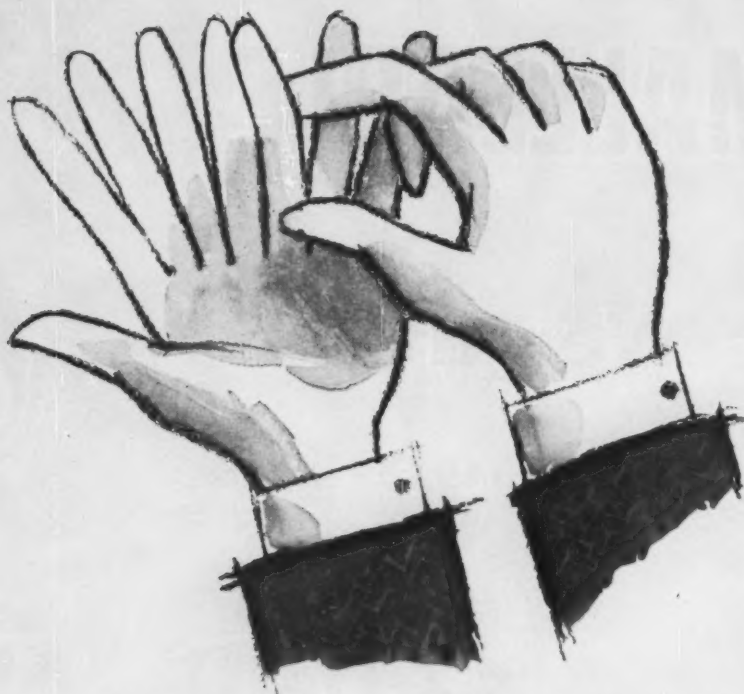
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WISCONSIN

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CERAMIC TOOL MATERIAL—See Tool
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gueroa, Gardena, Calif.
Cross Co., P.O. Box 3835, Park Grove Postal
Sta., Detroit 5, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland,
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New Britain Mch. Co., New Britain-Gridley Mch.
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National Acme Co., 170 E. 131st St., Cleve-
land, Ohio
Sundstrand Mch. Tool Co., 2531 11th St.,
Rockford, Ill.
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CHUCKS, Air Operated

Gisholt Machine Co., 1245 E. Washington Ave.,
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Logansport Machine Co., Inc., 810 Center Ave.,
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Schrader's Son, A., 470 Vanderbilt Avenue,
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Skinner Chuck Co., 95 Edgewood Ave., New
Britain, Conn.

CHUCKS, Collet

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zoo, Mich.
Delta Power Tool Div., 400 N. Lexington Ave.,
Pittsburgh 8, Pa.
Gisholt Machine Co., 1209 E. Washington Ave.,
Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine,
Wis.
Hardinge Bros. Inc., 1420 College Ave., Elmira,
N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National,
Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland
8 Ohio
New Britain Mch. Co., New Britain-Gridley Mch.
Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleve-
land 14, Ohio
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleve-
land 3, Ohio
Zagor, Inc., 24000 Lakeland Blvd., Cleveland
23, Ohio

**CHUCKS, Combination Universal-Inde-
pendent**

Buck Tool Co., 2015 Schippers Lane, Kalama-
zoo, Mich.
Geometric-Horton Div., United Greenfield Corp.,
New Haven, Conn.
Gisholt Machine Co., 1209 E. Washington Ave.,
Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National,
Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleve-
land 8, Ohio
Skinner Chuck Co., 95 Edgewood Ave., New
Britain, Conn.

CHUCKS, Compensating

Buck Tool Co., 2015 Schippers Lane, Kalama-
zoo, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Fi-
gueroa, Gardena, Calif.

Continued on page 234)

5 Basic Reasons why **MARVEL HACK SAWS** **CUT-OFF MORE ACCURATELY...**

The consistently accurate performance of MARVEL Heavy Duty Hack Saws is no accident. MARVEL engineers knew, many years ago, that to produce and maintain accurate cutting-off, a hack saw must be designed and built like a fine machine tool.

Some of the basic design principles built into the modern MARVEL Hack Sawing System that makes it the most accurate cutting-off method you can use are:

1. V-Way Design...Greater Rigidity

Upright and Saddle are precision machined and fitted to form a rigid, integral unit capable of withstanding any cutting load with no deflection or side movement.

2. Anti-Friction Bearing Construction

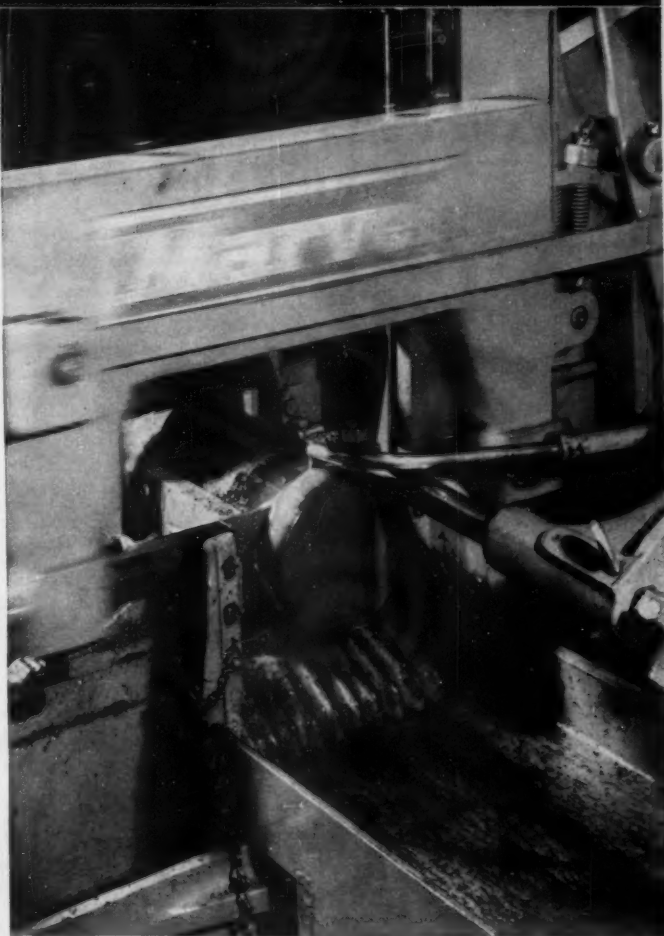
Anti-friction ball or roller bearings are used at all load carrying points. Even the strongly braced saw frame reciprocates on heavy duty, fully enclosed preloaded ball bearings which provide permanent, frictionless rigidity and true-running, straight line cutting strokes.

3. Minimum Blade Frame Reach

Close-coupled design and crank lever action of MARVEL Saws keeps the saw frame and blade reach very short in relation to the vertical V-ways on which the unit is mounted. This insures optimum rigidity, even under the most severe operating conditions.

4. Positive Relief Blade Lift

On the return stroke, positive relief lift raises the blade to provide proper and "cushioned" lead-in on the next cutting stroke. This prolongs blade sharpness, life and accuracy.



5. Rigid Cutting Tool

Cutting-off accuracy requires a rigidly held, relatively short cutting tool. MARVEL Unbreakable High-Speed-Edge Hack Saw Blades, which combine a narrow high speed steel cutting edge permanently welded to a tough alloy steel body, can be tensioned from 200% to 300% more taut than ordinary blades. This provides a most rigid cutting edge.

Catalog C85 has complete details, facts and figures on both Marvel metal cutting Hack Saws and Band Saws. Write for it today.



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Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
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CHUCKS, Lathe

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Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.

Logansport Mch. Co., Inc., Logansport, Ind.
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Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio

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Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
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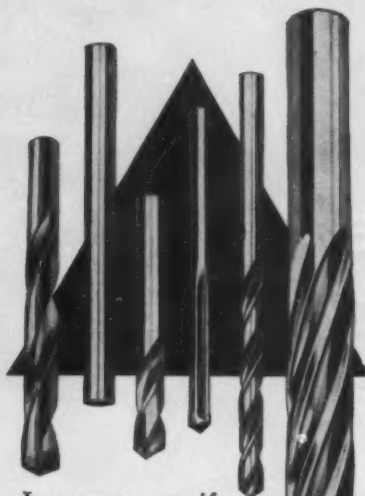


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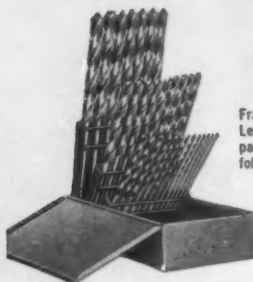
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DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Mott & Meryweather Mch. Co., 888 E. 70th St., Cleveland 3, Ohio.
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Johnson, S. C. & Son, Inc., Racine, Wis.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Modern Machine Tool Co., Jackson, Mich.

CUTTING-OFF SAWS, Abrasive Wheel

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Johnson Manufacturing Co., Albion, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.
Ty-Sa-Man Machine Co., Inc., 1093 White Ave., Knoxville, Tenn.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

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Logansport Mch. Co., Inc., Logansport, Ind.
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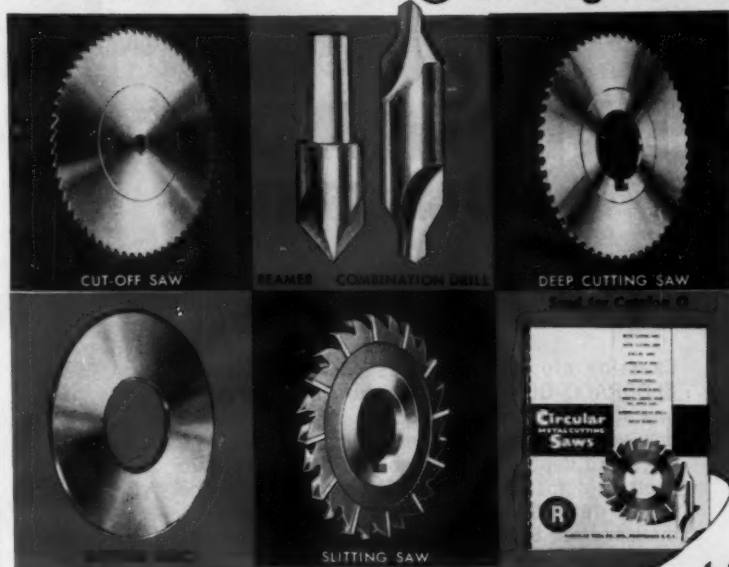
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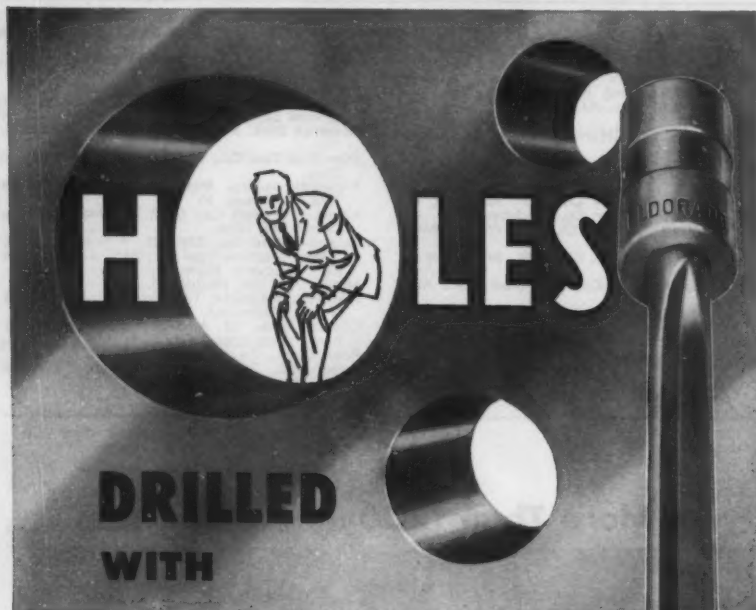
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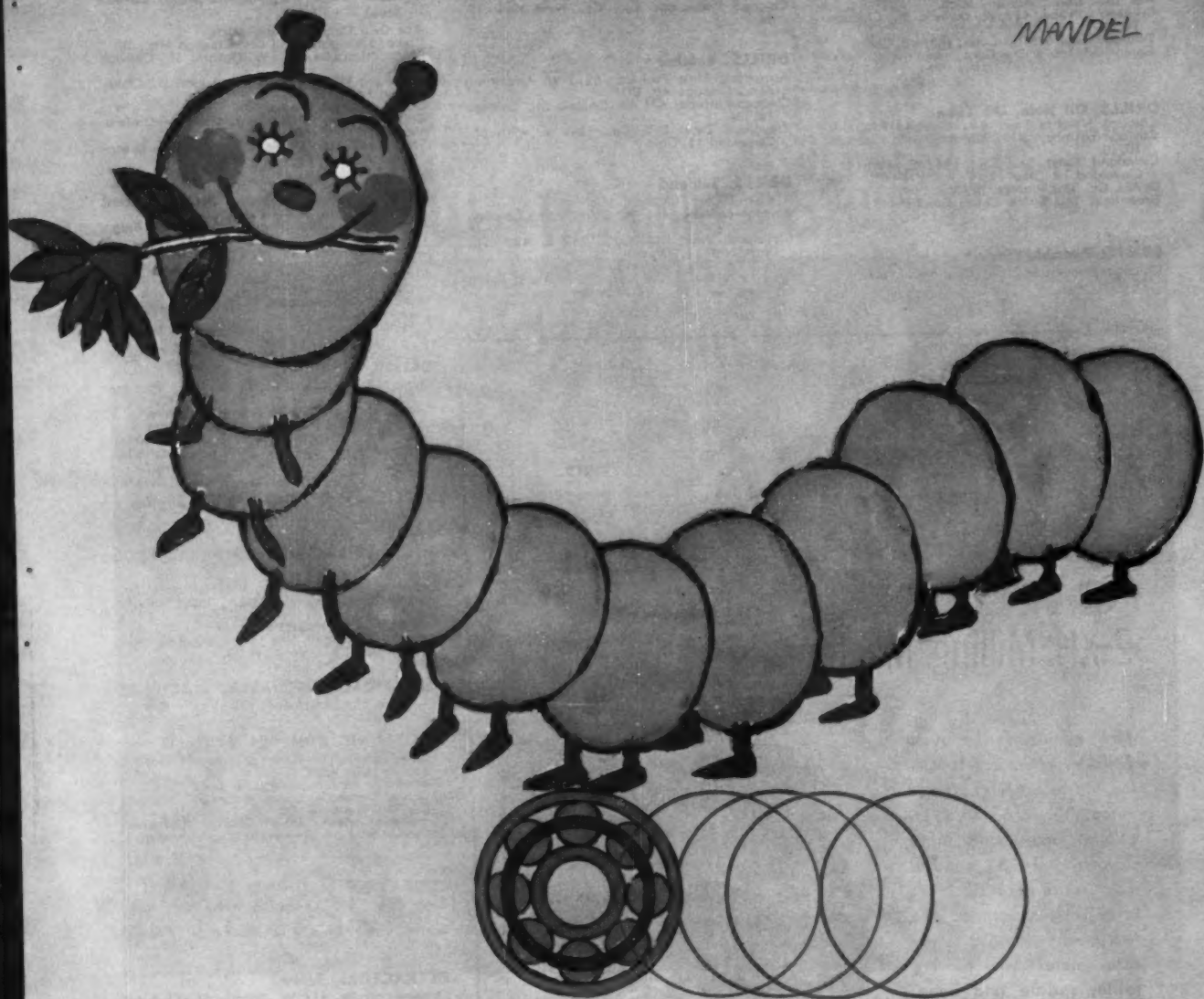
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Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Portable pneumatic

Chicago Pneumatic Tool Co., New York 17, N. Y.

DRILLS, Ratchet

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio

DRILLS, Subland

Ace Drill Corp., Adrian, Mich.
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio.

DRILLS, Twist, High-Speed Steel, Carbon Steel

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Chicago Heights Steel Co., Chicago Hts., Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
DoALL Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Mohawk Tools, Inc., Montpelier, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

DRILLS, Twist, Carbide, Carbide-Tipped

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Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
DoALL Co., Des Plaines, Ill.
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

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Cogswill Twist Drill Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
National Twist Drill & Tool Co., Rochester, Mich.

DUPLICATING ATTACHMENTS—See Tracing Attachments**DUST COLLECTORS AND CONTROL SYSTEMS**

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Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Pangborn Corp., Hagerstown, Md.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 14, Ohio

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Micro-Path Inc., Inglewood 2, Calif.
Reliance Electric & Engrg. Co., 1200 Ivanhoe Rd., Cleveland 10, Ohio
Stromberg-Carlson Div., General Dynamics Corp., 1493 N. Goodman St., Rochester 3, N. Y.

ENGRAVING MACHINES

Casa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton, Geo., Mach., 1321 Racine St., Racine, Wis.

EXTRACTORS, Screw

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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio
Greenfield Tap & Die Corp., Greenfield, Mass.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

FACING HEADS

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cress Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis Boring Tool Div., Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Mummert-Dixon Co., Hanover, Pa.

FANS, Exhaust, Ventilating

Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

FASTENERS

Allen Mfg. Co., Bloomfield, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Russell, Burdall & Ward Bolt & Nut Co., Port Chester, N. Y.
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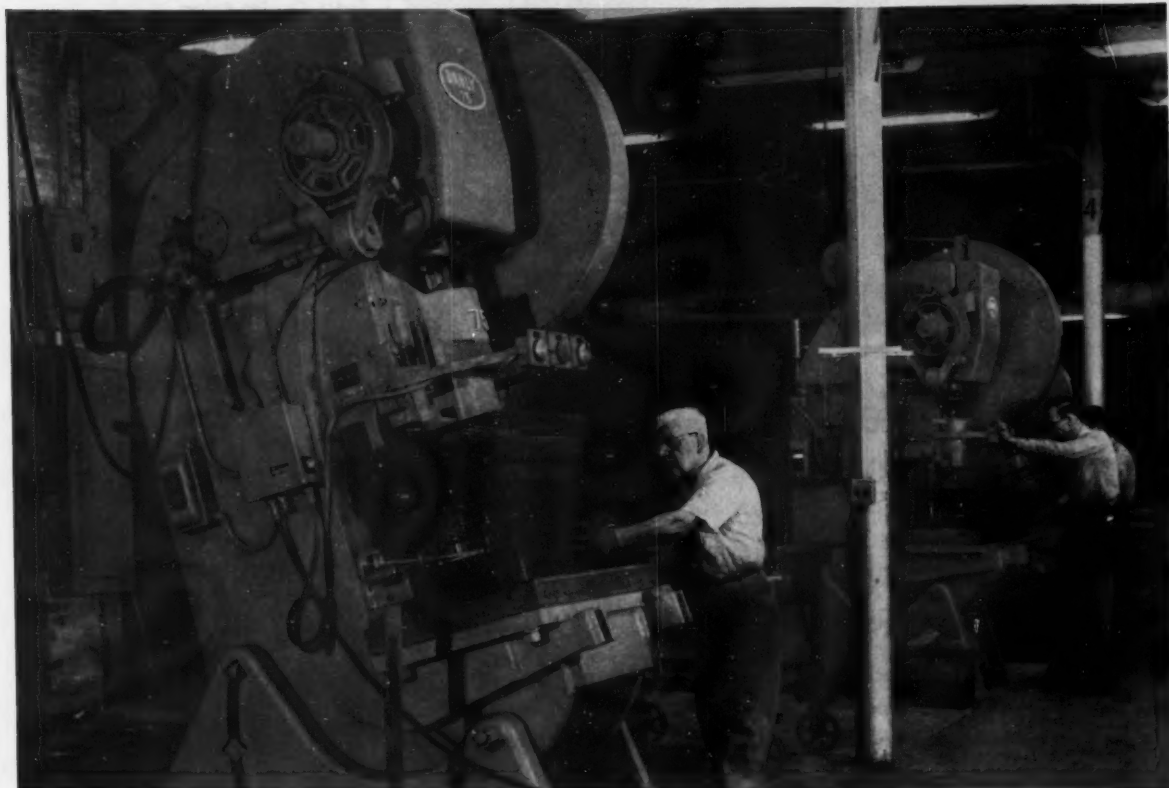
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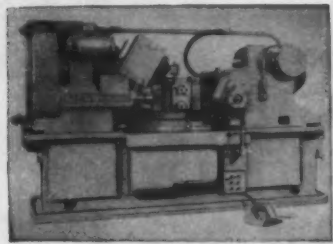


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FILES, General-purpose, Swiss Pattern

DoALL Co., Des Plaines, Ill.

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Wyman-Gordon Co., Worcester, Mass.

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Mueller Brass Co., Port Huron 35, Mich.
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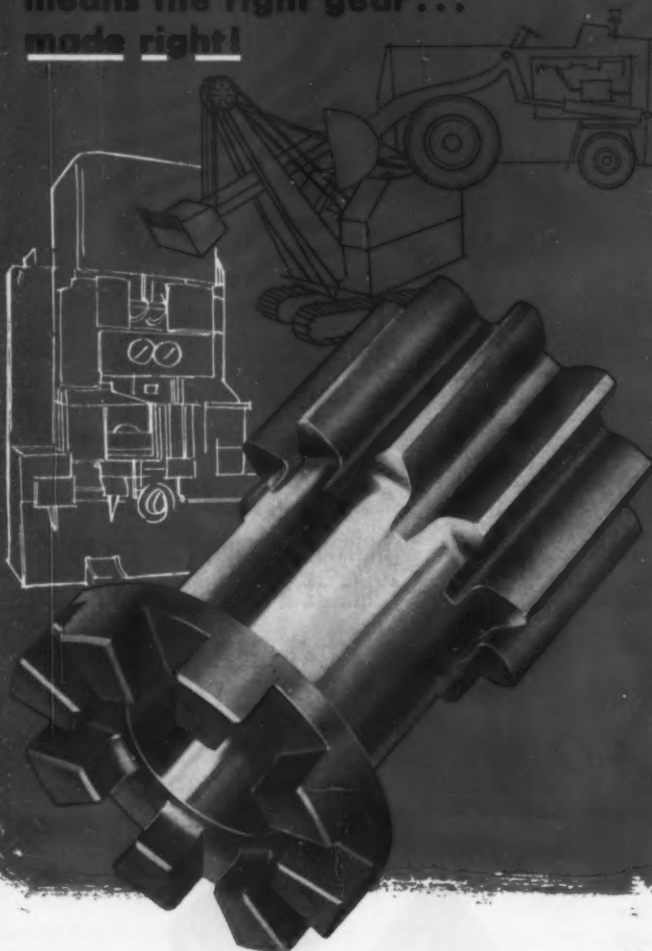
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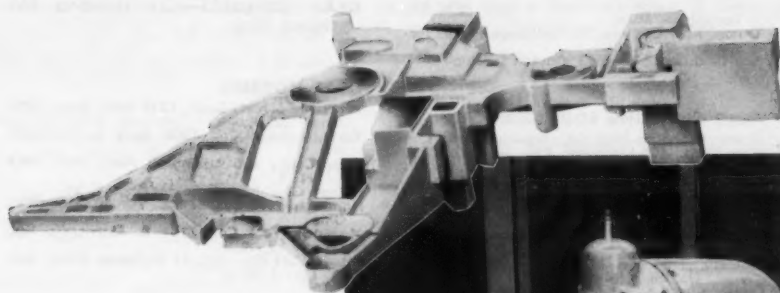
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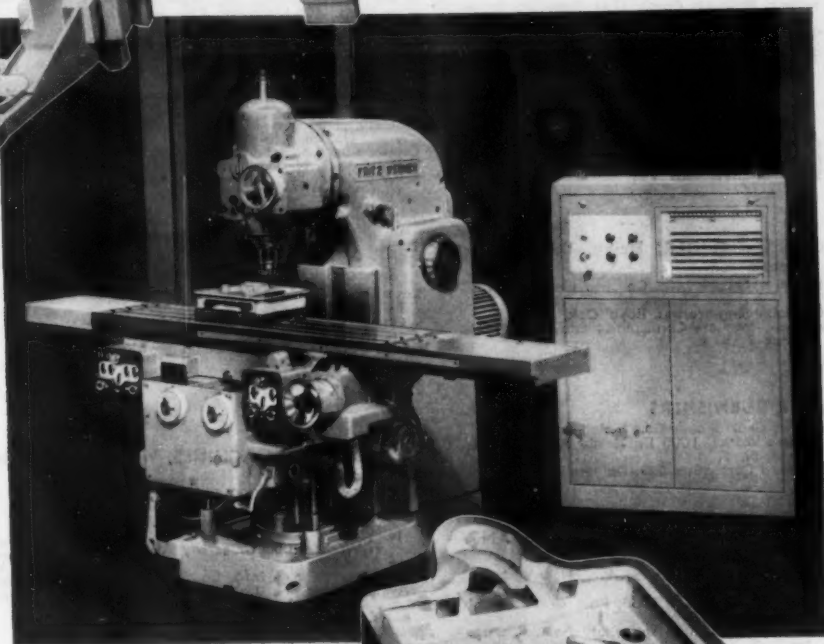
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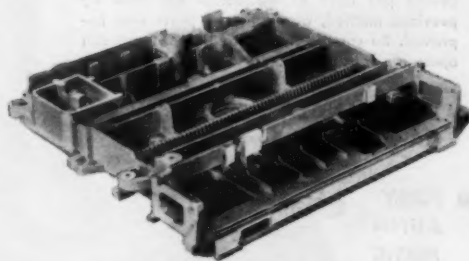
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 Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
 Illinois Gear & Mch. Co., 2108 N. Natchez Ave., Chicago 5, Ill.
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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

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Elox Corp. of Michigan, Troy, Mich.
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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

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Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

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Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

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Madison-Kipp Corp., Madison, Wis.
Onsrud Machine Works, Inc., Niles, Ill.

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Elox Corp. of Michigan, Troy, Mich.
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Gleason Works, 1000 University Ave., Rochester 3, N. Y.

Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.
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National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

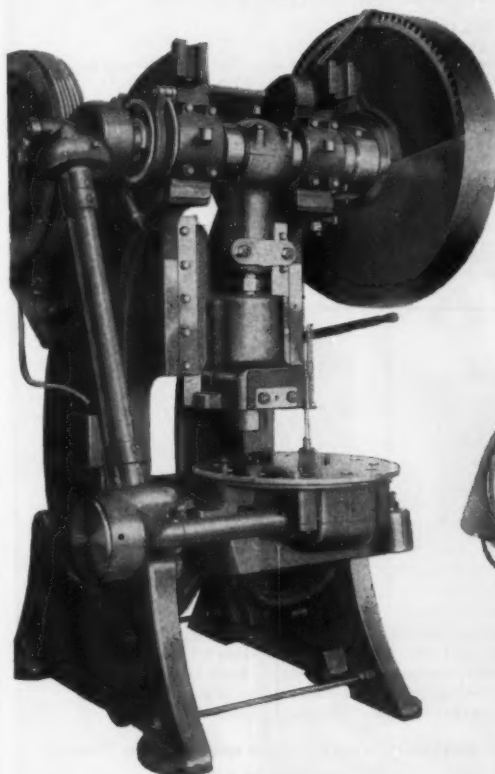
GRINDERS, Toolpost

Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

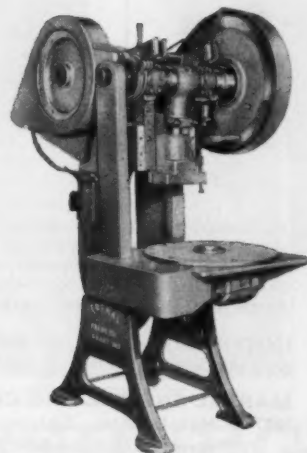
GRINDING GAGES—See Gages, Grinding

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FOR DEPENDABLE PROTECTION on all Hydraulic and other low pressure circulating systems

Designed to give more ACTIVE filtering area—MORE dependable protection—MORE productive operation before cleaning is necessary. Meet J.I.C. Standards.



A—Synclinal SUMP TYPE

CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: 3/4"—1"—1 1/4"—1 1/2"—2"—2 1/2" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not available.

B—Synclinal LINE TYPE

CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: 3/4"—1"—1 1/4"—1 1/2"—2"—2 1/2" and 3".
BY-PASS VALVE: Not available.
OPERATING PRESSURES: Up to 80 p.s.i.

C—Bonded LINE TYPE

CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1 1/4"—1 1/2"—2" and 2 1/2".
BY-PASS VALVE: Available with or without.
OPERATING PRESSURE: Up to 250 p.s.i.
OPERATING TEMPERATURES up to 300° F.

D—IN-LINE FILTER

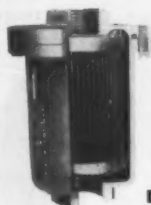
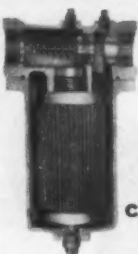
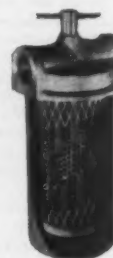
CAPACITIES: Up to 60 G.P.M.
PIPE SIZES: 3/4"—1"—1 1/4" and 1 1/2" (at both inlet and outlet).
BY-PASS VALVE: Available with or without.

E—Bonded SUMP TYPE

CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1 1/4"—1 1/2"—2" and 2 1/2".
CONNECTIONS: Coupling—"O" Ring—Male Nipple.
BY-PASS VALVE: Available with or without.

F—Tandem SUMP TYPE

CAPACITIES: 10—16—20—40—60—100—150 and 200 G.P.M.
PIPE SIZES: 3/4"—1"—1 1/4"—1 1/2"—2"—2 1/2" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not available.



FILTERING MEDIA in all Marvel Filters is Monel wire cloth available in mesh sizes of 30-40-50-60-80-100-150 and 200 to meet your filtration requirement.

EASY TO CLEAN—All Marvel Filters are easy to clean. Line type units operate in any position and may be serviced without disturbing pipe connections.

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☐ Water ☐ Sump Type ☐ Line Type ☐ In-Line

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Company _____

Address _____

City _____

State _____

(MY-1)

GRINDING MACHINES, Abrasive Belt

Hammond Machinery Builders, Inc., Kalamazoo, Mich.
 Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
 Mattison Mch. Works, Rockford, Ill.
 Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach

Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
 Lapointe Machine Tool Co., Hudson, Mass.
 National Broach & Mch. Co., 5600 St. Jean Detroit 13, Mich.
 Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Landis Tool Co., Waynesboro, Pa.
 Norton Co., 1 New Bond St., Worcester 6, Mass.
 Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless

Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
 Landis Tool Co., Waynesboro, Pa.
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Crankshaft

Landis Tool Co., Waynesboro, Pa.
 Norton Co., 1 New Bond St., Worcester 6, Mass.
 Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
 Hammond Machinery Builders, Inc., Kalamazoo, Mich.
 Landis Tool Co., Inc., Waynesboro, Pa.
 Micromatic Hone Corp., 81,000 Schoolcraft Ave., Detroit 38, Mich.
 Norton Co., 1 New Bond St., Worcester 6, Mass.
 Sheffield Corp., Box 893, Dayton 1, Ohio
 Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc

Brown & Sharpe Mfg. Co., Providence, R. I.
 Gardner Machine Co., Beloit, Wis.
 Mattison Machine Co., Beloit, Wis.
 Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Fellows Gear Shaper Co., Springfield, Vt.
 Gear Grinding Machine Co., 3901 Christopher St., Detroit 11 Mich.
 Gleason Works, 1000 University Ave., Rochester 3, N. Y.
 National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
 Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
 Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Internal

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
 Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
 Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
 Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
 Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Fostick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
 Gallmeyer & Livingston Co., 336 Straight S. W., Grand Rapids 2, Mich.
 Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

GRINDING MACHINES, Profile

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
 Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
 Jones & Lamson Mch. Co., Springfield, Vt.
 Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll

Landis Tool Co. Inc., Waynesboro, Pa.
 Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating

Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 DeAll Co., Des Plaines, Ill.
 Elax Corp. of Michigan, Troy, Mich.
 Gallmeyer & Livingston Co., 336 Straight, S.W., Grand Rapids 4, Wis.
 Gardner Machine Co., Beloit, Wis.
 Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
 Mattison Machine Works, Rockford, Ill.
 Norton Co., 1 New Bond St., Worcester 6, Mass.
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
 Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Surface Rotary

Berthiez, Charles, 5 Rue Montalivet, Paris, France
 Blanchard Machine Co., 64 State St., Cambridge, Mass.
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Gardner Machine Co., Beloit, Wis.
 Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
 Mattison Machine Works, Rockford, Ill.
 National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
 Norton Co., 1 New Bond St., Worcester 6, Mass.
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
 Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
 Walker, O. S. Co., Inc., Worcester, Mass.

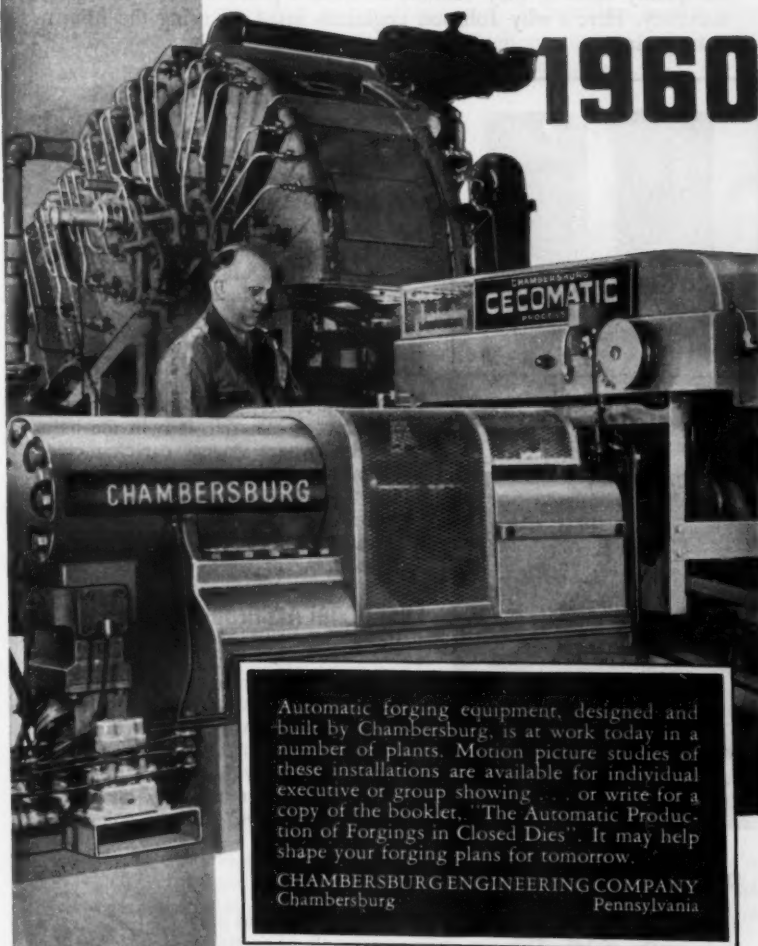
GRINDING MACHINES, Thread

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
 Jones & Lamson Mch. Co., Springfield, Vt.
 Landis Machine Co. (Centerless), Waynesboro, Pa.
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.
 Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
 Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
 Jones & Lamson Mch. Co., Springfield, Vt.
 Landis Tool Co. Inc., Waynesboro, Pa.
 Norton Co., 1 New Bond St., Worcester 6, Mass.
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Automatic forging equipment, designed and built by Chambersburg, is at work today in a number of plants. Motion picture studies of these installations are available for individual executive or group showing . . . or write for a copy of the booklet, "The Automatic Production of Forgings in Closed Dies". It may help shape your forging plans for tomorrow.

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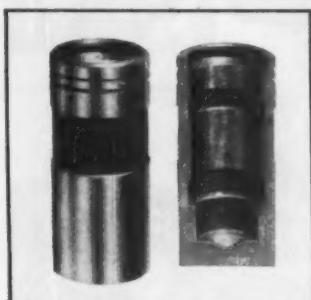
DESIGNERS AND MANUFACTURERS OF THE IMPACTER

When it's a vital part, design it to be **FORGED**

WHY MICROHONING*

of Valve Tappet Bores Assures Economical Production, Precision and Functional Surfaces

Johnson Products, Inc., (Muskegon, Michigan) is a pioneer in the manufacturing of hydraulic valve tappets. Placing strong emphasis on quality control, they demand consistent precision and geometric accuracy. Here's why Johnson engineers insist on using the Microhoning process.



Typical Johnson valve tappet — cross section shows interrupted, semi-blind-end bore.



Two of the double-spindle Hydrohoners, each spindle has its own sizing control.

Processing Economy

In a typical production run of 31,250 parts, scrap was only three-tenths of 1%. This is a striking example of economy resulting from consistent quality processing. The use of Microhoning also eliminated previously required precision boring—several boring machines were involved in this saving.

*Registered U.S. Pat. Off.

MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

Generates Clean-Cut Surfaces

Microhoning is a low-velocity abrading process that uses a combination of controlled speeds, feeds and motions to provide functional surfaces. Also, the large area of contact between abrasive and work surface spreads and easily dissipates the cutting heat. Thus, Microhoning generates clean-cut work surfaces that are free of burned or smeared metal.

Produces Longer-Wearing Surfaces

Because the Microhoned surface is cleared of amorphous material, it is in the base metal zone where longer-wear characteristics are more readily induced. Also, the unique Microhoning cross-hatch lay pattern provides a multitude of minute "plateaus" for equitable distribution of work load.

Functional Accuracy

Geometric accuracy is mandatory! For, there must be a clearance of .0002"-.0003" between tappet bore and its plunger. Microhoning consistently holds bores within the .00003" tolerance for roundness and straightness, and within .0005" for size. Proof—each tappet assembly must pass a critical "leak-down" test.



Olivetti Corp of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.

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Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING WHEELS

Blanchard Machine Co., 64 State St., Cambridge, Mass.
Cincinnati Milling Machine Company, Cincinnati Milling Products Div., Marburg Ave., Cincinnati 9, Ohio
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Metal Carbides Corp., Youngstown, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.

GROOVING TOOLS, Internal

Kennametal, Inc., Latrobe, Penna.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 33, Penna.
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

HAMMERS, Drop—See Forging Hammers

HAMMERS, Portable Pneumatic

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HAMMERS, Power

Chambersburg Engrg. Co., Chambersburg, Pa.
Edlund Mchry. Co. Div., Cortland, N. Y.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

HARDENING FURNACES

General Electric Co., Schenectady, N. Y.

HARDNESS TESTERS

Shore Instrument & Mfg. Co., 90-35C Van Wyck Exp., Jamaica 35, N. Y.

HEAT-TREATING EQUIPMENT — See Annealing Furnaces, Flame Hardening Machines, Induction-Heating Equipment

HOBS

Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Twist Drill & Tool Co. Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

HOISTS, Air

Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

HOISTS, Electric

Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

HONING MACHINES

Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Moline Tool Co., 102-120th St., Moline, Ill.
Superior Hone Corp., 1623 Elreona St., Elkhart, Ind.

Van Norman Machine Co., 3640 Main St.,
Springfield 7, Mass.

HONING STONES

Barnes Drill Co., 814 Chestnut Rockford, Ill.
Micromatic Hone Corp., 8100 Schoolcraft Ave.,
Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6,
Mass.

HOSE

American Metal Hose Br. American Brass Co.,
35 Broadway, New York, N. Y.
Schrader's Son, A., 470 Vanderbilt Ave.,
Brooklyn 38, N. Y.

HYDRAULIC MACHINERY

Tools and equipment

Barnes Drill Co., 814 Chestnut St., Rockford,
Ill.
Bethlehem Steel Corp., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro,
Pa.
Bliss E. W. Co., 1375 Raff Rd., E. W. Can-
ton, Ohio
Burg Tool and Mfg. Co., Inc., 15001 S. Fi-
gueroa, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
Denison Engineering Div. American Brake Shoe
Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries,
1150 Tennessee Ave., Cincinnati 29, Ohio
Erle Foundry Co., Erie, Pa.
Hannifin Co., Div. Parker-Hannifin Corp., Des
Plaines, Ill.
Hydraulic Press Mfg., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd.,
Detroit 34, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave.,
Detroit 4, Mich.
Northern Hydraulics & Mch. Corp., Melrose
Park, Ill.
Olgeer Co., 1569 W. Pierce St., Milwaukee,
Wis.
Rockford Mch. Tool Co., 2500 Kishwaukee St.,
Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St.,
Rockford, Ill.
Verson Allsteel Press Co., 93rd St. & S. Ken-
wood Ave., Chicago, Ill.
Vickers Incorporated Div. of Sperry Rand
Corp., 1402 Oakman Blvd., Detroit, Mich.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

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Barnes Drill Co., 814 Chestnut, Rockford 3, Ill.
Barnes W. F. & John Co., 201 S. Waterford
St., Rockford, Ill.
Denison Engineering, Div. American Brake Shoe
Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries,
1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
32, Mich.
Hartford Special Machinery Co., 287 Home-
stead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd.,
Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph
Rd., Dearborn, Mich.
Olgeer Co., 1569 W. Pierce St., Milwaukee,
Wis.
Vickers Incorporated, Div. of Sperry Rand Cor-
poration, 1402 Oakman Blvd., Detroit, Mich.

INDEXING and SPACING EQUIPMENT

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch.
Div., Marburg Ave., Cincinnati 9, Ohio
Elaser Engrg. Co., Inc., 750 South 13th St.,
Newark, N. J.
Equitable Engineering, Royal Oak, Mich.
Hardinge Bros., Inc., 1420 College Ave., El-
mira, N. Y.
Kearney & Trecker Corp., 6784 W. National,
Milwaukee 14, Wis.
Opto-Metric Tools, Inc., 137 Varick St., New
York, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rock-
ford, Ill.
Van Norman Machine Co., 3640 Main St.,
Springfield 7, Mass.

INDICATOR BASES, Magnetic

Brown & Sharpe Mfg. Co., 235 Promenade St.,
Providence 1, R. I.
du Mont Corp., Greenfield, Mass.
Orbon Kurt Co., Inc., 42 Exchange Place, Jer-
sey City 2, N. Y.

HOW MICROHONING

of Valve Tappet Bores

Generates Accuracy Within .00003,"

Eliminates Boring, Cuts Scrap Losses

To obtain functional surface qualities, engineers at Johnson Products, Inc. are insisting on Microhoning the bores of hydraulic valve tappets designed for long service or punishing usage. In addition, here is how Microhoning also generates consistently high accuracy, eliminates an extra operation and reduces scrap losses to a minimum.

Automatic, Consistent Precision

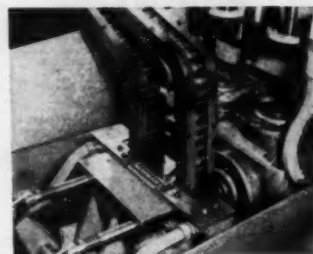
Pictured is a line of four Model 738 Microhonors that typify the Microhoning equipment used by Johnson Products. Each machine has: automatic stonefeed and stonewear compensation (Microdial); automatic sizing unit (Gage Ring Air-Switch Microsize); air operated raising and lowering of fixture table assembly is synchronized with head controls for automatic operation.



Result: Johnson automatically obtains consistent precision as evidenced by these several facts. Microhoned bores are held within .00003" tolerance for roundness and straightness, within .0005" for size, and a specified surface finish of 12-14 microinches (rms) is generated. Also, from a typical production run of 31,250 parts, only three-tenths of 1% was scrap—a striking example of processing control and low scrap loss.

Flexible and Efficient Processing

Bore diameters of Microhoned tappets range from .656" to .800", and lengths from 1" to 2". Material is either cast iron, or iron alloy hardened to 55-60 R "C". In all, 15 different combinations of sizes and materials are Microhoned. Typical fixturing is shown to the right—it is designed to keep changeover time at a minimum.



From .004" to .005" stock is removed during the Microhoning cycle of 18 to 21 seconds. Cutting efficiency is boosted by the design of special Micromold tools. Intraflow features (within the tools) supply coolant directly to cutting zone.



We will gladly send more information on the
Microhoning process and equipment—
WRITE FOR FREE LITERATURE

MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

Lepel
HIGH FREQUENCY
HEATING
UNITS

Lepel induction heating equipment represents the most advanced thought in the field of electronics... the most practical and efficient source of heat developed for numerous industrial applications. You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations.

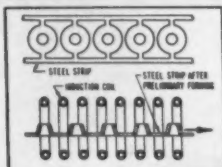
TYPICAL INDUCTION HEATING APPLICATIONS

PLASTIC COATING OF TOOL HANDLES



A production line operation for coating handles of tools at Whitney Metal Tool Co., Rockford, Ill. uses induction heating with excellent results. The handles only are heated by induction to the desired temperature then dipped into a vinyl chloride base coating material for a short period depending upon the thickness of coating desired. The plastic coating formed on the handles is then cured by immersion in a carbo-wax bath.

FORMING OF METAL STRIP FACILITATED BY PROGRESSIVE ANNEALING



Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

Electronic Tube Generators from 1 kw to 150 kw.
Spark Gap Converters from 2 kw to 30 kw.

WRITE FOR THE NEW LEPEL CATALOG

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55th STREET and 30th AVENUE, WOODSIDE 17, N. Y.

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Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th-N. Sts., Richmond, Ind.

INDICATORS, Speed

Brown & Sharpe Mfg. Co., Providence, R. I.
Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
General Electric Co., Schenectady, N. Y.

INDICATORS, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
National Automatic Tool Co., S. 7th & N. Sts., Richmond, Ind.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

INDUCTION HEATING EQUIPMENT

Cincinnati Milling Machine Co., Meta-Dynamics Div., Marburg Ave., Cincinnati 9, Ohio
General Electric Co., Schenectady, N. Y.
Lepel High Frequency Laboratories, Inc., Woodside 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. Y.

INTENSIFIERS, Hydraulic

Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.

JACKS, Planer—See Set-Up Equipment

JIG BORERS

American Sip Corp., 100 E. 42nd St., New York 17, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Fosdick Mch. Tool Co., 1638 Blue Rock, Cincinnati 23, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

JIGS AND FIXTURES

Bath, Cyril Co., Aurora & Solon Road, Solon, Ohio
Columbus Die Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio
Hartford Special Mchry. Co., 287 Homestead Ave., Hartford, Conn.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Metal Carbides Corp., Youngstown 12, Ohio
Sheffield Corp., 721 Springfield St., Dayton 1, Ohio

KEYSEATERS

Baker Bros Inc., Station F, P. O. Box 101, Toledo 10, Ohio
Bliss, E. W. Co., Canton, Ohio
Mitts & Merrill, 1809 S. Water St., Saginaw, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

KNURLING TOOLS

Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Williams J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LAPPING MACHINES

Cincinnati Milling Machine Co., Grinding Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
DoALL Co., Des Plaines, Ill.
Ex-Cap-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gleason Works, 1000 University Ave., Rochester, N. Y.
Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.

LATHE ATTACHMENTS

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
Sheldon Mch. Co., Inc., 4235 N. Knox Ave., Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio
Williams J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

LATHES, AUTOMATIC—See Chucking Machines

LATHES, Axle

Consolidated Mch. Tool Div., Farrel-Birmingham Co., Inc., Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Bench

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

LATHES, Car Wheel

Bullard Co., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio

LATHES, Copying, Duplicating — See Lathes, Duplicating

LATHES, Center Drive

Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.

LATHES, Crankshaft

Consolidated Mch. Tool Corp., Rochester, N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

LATHES, Double-End

Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
Consolidated Mch. Tool Corp., Rochester N. Y.
LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette Detroit 7, Mich.
Sundstrand Mch. Tool Co., 2351 11th St., Rockford, Ill.

LATHES, Duplicating

Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Monarch Machine Tool Co., 27 Oak St., Sidney Ohio
Sidney Machine Tool Co., Highland Ave., Sidney, Ohio

LATHES, Engine, Manufacturing

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
Carroll-Jamieson Mch. Tool Co., Batavia, Ohio
Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.

Henley Mch. Div., Barber Colman Co., Rockford, Ill.
 Lapointe Machine Tool Co., Hudson, Mass.
 LeBlond, R. K. Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
 Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
 Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
 Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
 Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Engine, Toolroom

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati, Ohio
 Carroll-Jamieson Mach. Tool Co., Batavia, Ohio
 Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
 Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
 Hardinge Bros. Inc., 1420 College Ave., Elmhurst, N. Y.
 Henley Mch. Div., Barber Colman Co., Rockford Ill.
 LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
 Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
 Logan Engineering Co., 4901 Lawrence Ave., Chicago 30, Ill.
 Monarch Machine Tool Co., 27 Oak St., Sidney, Ohio
 Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Rockford Machine Tool Co., 2500 Kishwaukee St., Rockford, Ill.
 Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.
 Sidney Mch. Tool Co., Sidney, Ohio

LATHES, Gap

Cincinnati Lathe & Tool Co., 3207 Disney St., Cincinnati 9, Ohio
 Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
 Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
 Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
 Nebel Machine Tool Corp., 3401 Central Pkwy., Cincinnati 25, Ohio
 Sidney Machine Tool Co., Highland Ave., Sidney, Ohio

LATHES Hollow Spindle

Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
 Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
 South Bend Lathe Works Inc., 425 E. Madison St., South Bend, Ind.

LATHES, Roll

American Tool Works Co., Pearl and Eggleston Aves., Cincinnati 2, Ohio
 Bliss E. W. Co., Canton, Ohio
 Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
 LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
 Monarch Mch. Tool Co., Oak St., Sidney, Ohio
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

LATHES, Speed, Second-operation

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 Hardinge Bros., Inc., 1420 College Ave., Elmhurst, N. Y.
 LeBlond, R. K., Mch. Tool Co., Madison and Edwards Rds., Cincinnati 18, Ohio
 Monarch Mch. Tool Co., Oak St., Sidney, Ohio
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Sheldon Mch. Co., 4258 N. Knox Ave., Chicago 41, Ill.
 Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio

LATHES, Spinning

Cincinnati Milling Machine Co., Meta-Dynamics Div., Marburg Ave., Cincinnati 9, Ohio (Hydrospin)
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Lodge & Shipley Co., The, Cincinnati 25, Ohio
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.



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LATHES, Toolroom—See Lathes, Engine, Toolroom

LATHES, Turret, Automatic

Bullard Co., Bridgeport 2, Conn.
 Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Casa Corp., 405 Lexington Ave., New York 17, N. Y.
 Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
 King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
 National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
 New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.

LATHES Turret, Ram Type, Saddle Type
 Bardons & Oliver, Inc., 1133 W. Ninth St., Cleveland 13, Ohio
 Bullard Co., Bridgeport 2, Conn.

Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Coag Corp., 405 Lexington Ave., New York 17, N. Y.
 Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 Hardinge Brothers, Inc., 1420 College Ave., Elmira N. Y.
 Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
 Lapointe Machine Tool Co., Hudson, Mass.
 New Britain Mch. Co., New Britain-Gridley Div., New Britain, Conn.
 Sheldon Mch. Co., Inc., 4258 N. Knox Ave., Chicago 41, Ill.
 Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio

LATHES, Turret, Vertical—See Boring Mills, Vertical

LAYOUT and DRAFTING TOOLS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.

LIMIT SWITCHES—See Switches, Limit

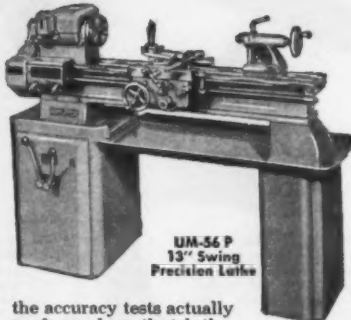
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Precision Lathe

the accuracy tests actually performed on that lathe. (19 checks).

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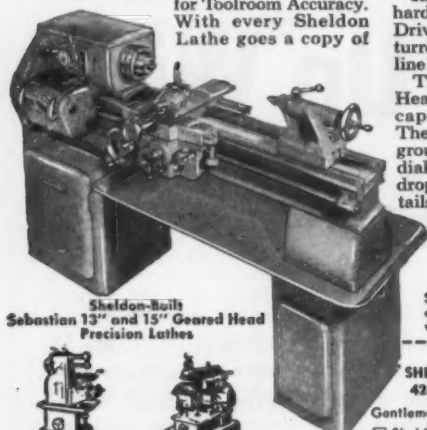
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Precision Lathes



SHELDON
Horizontal Milling Machine



SHELDON
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 Shell Oil Co., 50 W. 50th St., New York, N. Y.
 Standard Oil Co. (Indiana), 910 S. Michigan, Chicago, Ill.
 Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
 Texaco, Inc., 135 E. 42nd St., New York 17, N. Y.

LUBRICATING SYSTEMS

Madison-Kipp Corp., Madison, Wis.
 Trabon Engineering Corp., Solon, Ohio

MACHINERY, Used and Rebuilt

Eastern Mchry. Co., 1000 Tennessee Ave., Cincinnati, Ohio
 Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 Miles Mchry. Co., 2025 E. Genesee Ave., Saginaw, Mich.
 Match & Merryweather Mchry. Co., 888 E. 70th St., Cleveland 3, Ohio
 Van Keuren Co., Watertown 72, Mass.

MACHINISTS' SMALL TOOLS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
 DoALL Co., Des Plaines, Ill.
 Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
 Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
 Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

MANDRELS—See Arbors and Mandrels

MARKING MACHINES and DEVICES

Gorton Mch. Co., 1321 Racine St., Racine, Wis.
 Pannier Corp., 319 Pannier Bldg., Pittsburgh 12, Pa.

MATERIAL-HANDLING TRUCKS—See Trucks, Material Handling

MEASURING MACHINES

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
 Sheffield Corp., 721 Springfield St., Dayton 1, Ohio
 Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MEASURING WIRES, Thread, Spline, Gear

Sheffield Corp., Dayton 1, Ohio
 Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
 Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

MICROMETER HEADS

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
 DoALL Co., Des Plaines, Ill.

MICROMETERS, Outside, Inside, Depth

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
 DoALL Co., Des Plaines, Ill.
 Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
 Slocumb, J. T. Co., Glastonbury, Conn.
 Van Keuren Co., 176 Waltham St., Watertown 12, Mass.

MICROSCOPES, Toolmakers'

DoALL Co., Des Plaines, Ill.
 Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
 Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

MILLING MACHINE ATTACHMENTS

Bridgeport Mchrs., Inc., 500 Lindley St., Bridgeport 6, Conn.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
 Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
 Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio
 Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
 Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
 Nichols, W. H. Co., Waltham 54, Mass.

(Continued on page 258)



We think it's the largest forged hammer ram ever made

It weighs in at 50,000 pounds. And it measures 54¼ inches from top to bottom—59½ inches from side to side—66 inches from front to back. Here at Bethlehem, we've never heard of a larger *forged* hammer ram. Have you? If so, we'd certainly like to know the details. Would you be good enough to drop a line or two to Forgings Sales? (And end our suspense over whether we've chalked up another record, or an also-ran?)

A few other facts about this hammer ram: we forged it from nickel-chrome-molybdenum-vanadium steel; we heat-treated and tested it to our customer's specifications; and, as you can see, we furnished it finish-machined, ready to

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Although this ram is surely a giant in its class, it's a pygmy compared to some of the forgings we've made. Our shops turn out the largest forgings ever needed—some weighing over 200 tons. (Some of the smallest, too—drop forgings, for example, that weigh as little as one pound.)

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 in nonferrous milling

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 Van Norman Machine Co., 3640 Main St.,
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MILLING MACHINES, Automatic

Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
 Consolidated Machine Tool Corp., Rochester, N. Y.
 Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
 Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
 Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.
 Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
 Marac Machinery Corp., Yonkers, N. Y.
 Nichols, W. H. Co., Waltham 54, Mass.
 Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
 Onsrud Machine Works, Inc., Niles, Ill.
 Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
 U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

MILLING MACHINES, Bed Type,

Simplex, Duplex

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
 Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
 Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
 Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
 Match & Merryweather Mch. Co., 888 E. 70th St., Cleveland 3, Ohio
 Nichols, W. H. Co., Waltham 54, Mass.
 Olivetti Corp. of America, 42-33 Northern Blvd., Long Island 1, N. Y.
 Onsrud Machine Works, Inc., Niles, Ill.
 Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
 U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
 Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Bench, Hand

Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Hardinge Bros. Inc., 1420 College Ave., Elmira, N. Y.

**MILLING MACHINES, Circular,
 Continuous**

Consolidated Mch. Tool Corp., Rochester, N. Y.
 Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis.
 Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
 Nichols, W. H. Co., Waltham 54, Mass.
 Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
 Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
 Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

**MILLING MACHINES, Die Sinking,
 Duplicating, Profiling**

Bridgeport Mch., Inc., 500 Lindley St., Bridgeport 6, Conn.
 Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
 Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
 Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
 Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
 Elax Corp. of Michigan, Troy, Mich.
 Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
 Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
 Gorton, George, Machine Co., 1110 W. 13th St., Racine, Wis.
 Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
 Nichols, W. H. Co., Waltham 54, Mass.
 Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Knee Type, Horizontal, Plain, Universal

Brown & Sharpe Mfg. Co., Providence, R. I.
 Bullard Co., Bridgeport 6, Conn.
 Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio

Clearing Div., of U.S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gorton Geo. Mch. Co., 1110 W. 13th St., Racine, Wis.
Greaves Machine Tool Div., 2009 Eastern Ave., Cincinnati, Ohio
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Nichols, W. H. Co., Waltham 54, Mass.
Onsrud Machine Works, Inc., Niles, Ill.
Sheldon Machine Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

MILLING MACHINES, Knee Type Ram

Brown & Sharpe Mfg. Co., 235 Promenade St., Providence 1, R. I.
Gorton Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Bridgeport Mch., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cosa Corp., 450 Lexington Ave., New York 17, N. Y.
Gorton, George, Mch. Co., 11110 W. 13th St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

MILLING MACHINES, Planer Type

Berthiez, Charles, 5 Rue Montalivet, Paris, France
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., Woodburn Ave. and Penn R.R., Evanston, Cincinnati, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

Cincinnati Milling Machine Co., Special Machine Div., Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Onsrud Machine Works, Inc., Niles, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MOLDING MACHINES, Plastic

Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.

(Continued on page 260)



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Federal automatic resistance welders engineered to give Whirlpool the production they wanted without sacrificing famous Whirlpool quality. Federal welders are integral parts of many of Whirlpool's production lines, helping form and assemble at extra high speeds without breaking stride.

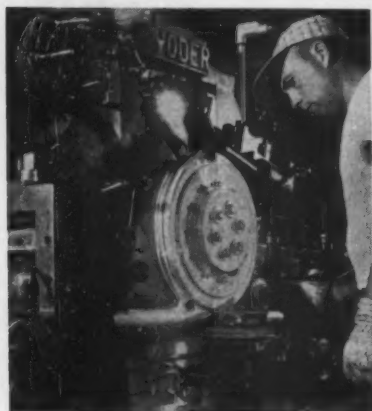
Leading metal fabricators from coast to coast, especially those who require high production and unsurpassed quality, have learned they can depend on the performance of Federal resistance welders and Warco mechanical presses, precision engineered by:

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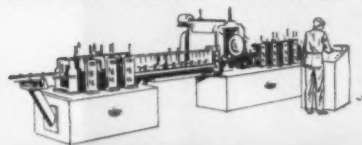
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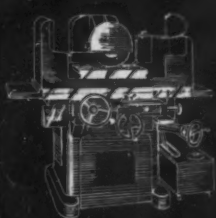
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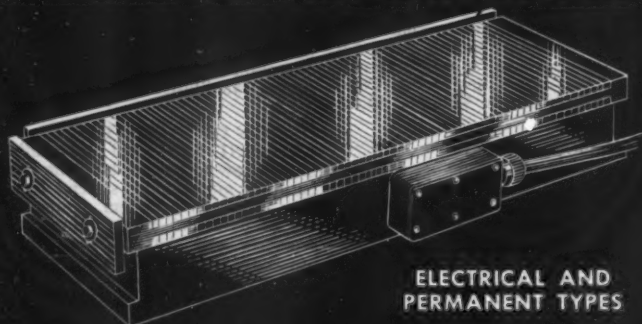
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(Continued on page 264)

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 Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
 Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
 Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
 Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
 Hydraulic Press Mfg. Co., Mount Gilead, Ohio
 Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
 Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
 Wilson, K. R., Inc., Arcade, N. Y.

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 Beatty Machine & Mfg. Co., Hammond, Ind.
 Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
 Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
 B-T Machinery Co., Holland, Mich.
 Chambersburg Engineering Co., Chambersburg, Pa.
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 Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
 Denison Engineering Div., American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
 Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
 Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
 Federal Machine and Welder Co., Warren, Ohio
 Federal Press Co., 511 Division St., Elkhart, Ind.
 Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
 Hydraulic Press Mfg. Co., Mount Gilead, Ohio
 L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
 Minster Machine Co., Minster, Ohio
 Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
 Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
 Wilson, K. R., Inc., Arcade, N. Y.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.**PULLEYS**

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 DoALL Co., Des Plaines, Ill.

PUMPS, Coolant and Lubricant

Barnes, John S. Corp., Rockford, Ill.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 DoALL Co., Des Plaines, Ill.
 Ingersoll-Rand Co., Phillipsburg, N. J.
 Loganport Machine Co., Inc., 810 Center Ave., Loganport, Ind.
 Ruthman Machinery Co., 1809 Reading Rd., Cincinnati 2, Ohio

PUMPS, Hydraulic

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 Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
 Hydraulic Press Mfg. Div., Mount Gilead, Ohio
 Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
 Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
 Wilson, K. R., Inc., Arcade, N. Y.

PUNCHES AND DIES—See Dies, Blanking, etc.**REAMERS, Rose, Chucking, Jobbers Taper, Shell, Adjustable, etc.**

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 Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
 Cleveland Twist Drill Co., 1242 49th St., Cleveland, Ohio
 Cogsdill Twist Drill Co., Greenfield, Mass.
 DoALL Co., Des Plaines, Ill.
 Greenfield Tap & Die Corp., Greenfield, Mass.
 Jarvis Corp., Stack Ave., Middletown, Conn.
 Tomkins-Johnson Co., Jackson, Mich.

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 U. S. Tool Co., Inc., 255 North 18th St., Amherst, E. Orange, N. J.

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Norton Co., 1 New Bond St., Worcester 6, Mass.

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Waldes Kohnor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.

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Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
 Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.

RIVETERS, Stationary

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 Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
 Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
 Tompkins-Johnson Co., Jackson, Mich.

ROTARY TABLES, Optical

Machine Products Corp., 6771 E. McNichols Rd., Detroit 12, Michigan

RULES, SCALES AND STRAIGHTEDGES

See Machinists' Small Tools

RUST INHIBITORS

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 Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
 Shell Oil Co., 50 W. 50th St., New York, N. Y.
 Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

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 Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
 DoALL Co., Des Plaines, Ill.
 Motch & Merryweather Mch. Co., 888 E. 70th St., Cleveland 3, Ohio

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 Motch & Merryweather Mch. Co., 888 E. 70th St., Cleveland 3, Ohio

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 Motch & Merryweather Mch. Co., 888 E. 70th St., Cleveland 3, Ohio
 Ty-Sa-Man Machine Co., Inc., 1093 White Ave., Knoxville, Tenn.

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 Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.

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 Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
 Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
 Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
 Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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 New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
 Scherr George Co., Inc., 200 Lafayette St., New York 12, N. Y.
 Warner & Swasey Co., 6701 Carnegie Ave., Cleveland 3, Ohio

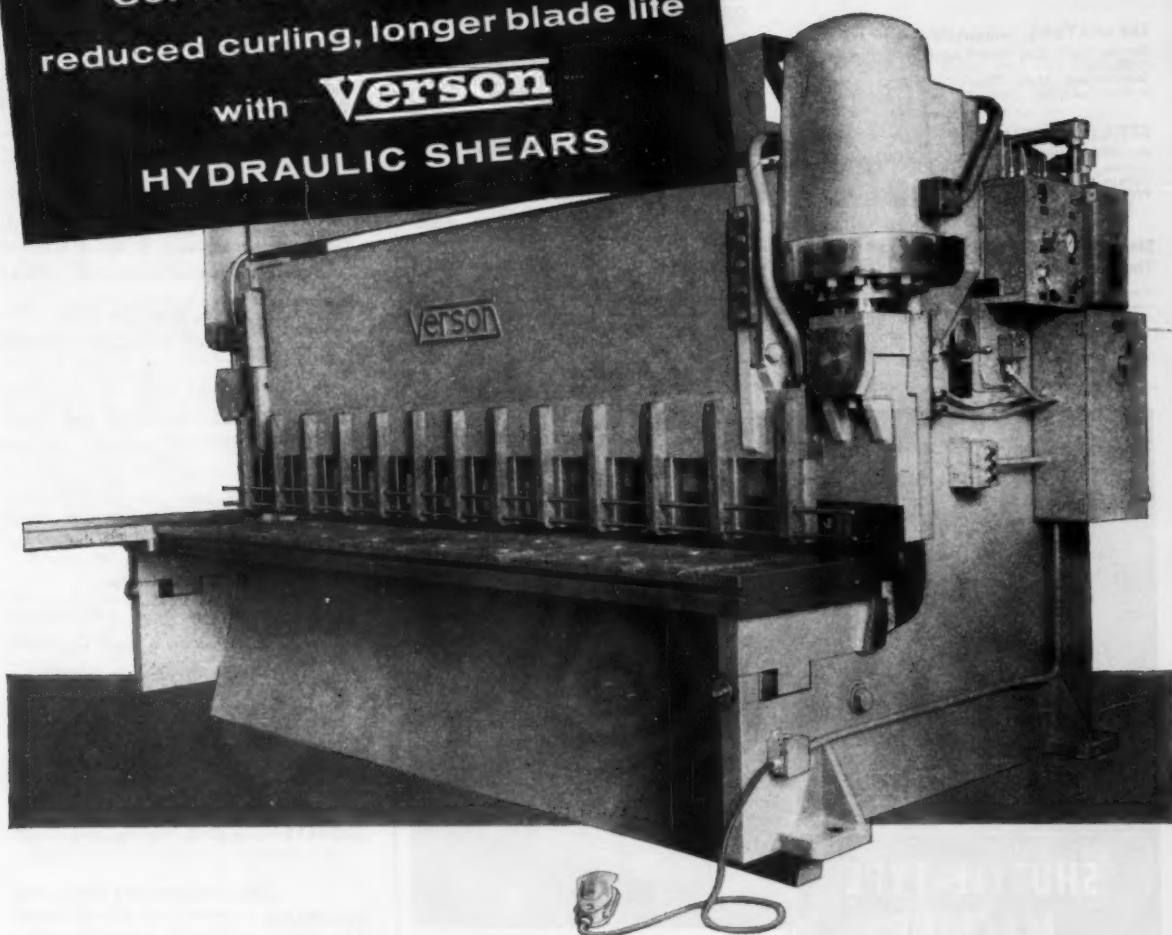
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 Gear Grinding Machine Co., 3901 Christopher St., Detroit 11, Mich.
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7, N. Y.

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Cosa Corp., 405 Lexington Ave., New York 17,
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Nebel Machine Tool Corp., 3401 Central Pkwy.,
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Orban Kurt Co., 42 Exchange Place, Jer-
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Sheldon Mch. Co., Inc., 4240-4258 N. Knox
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Lapointe Machine Tool Co., Hudson, Mass.
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City 2, N. J.
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Cincinnati Shaper Co., P. O. Box 111, Cincin-
nati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17,
N. Y.
Fanco Machine Co., Kenosha, Wis.
Lodge & Shipley Co., 3055 Colerain Ave., Cin-
cinnati 25, Ohio
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Ferrous, Non-ferrous

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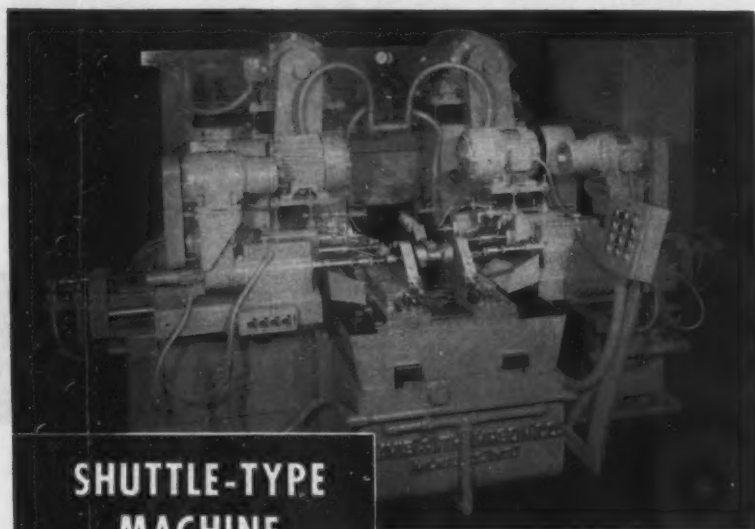
SLITTING MACHINES, Rotary
Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Works, 683 Northland
Ave., Buffalo 11, N. Y.
Waterbury Farrel Foundry & Mch. Co., Water-
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Ohio

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Slotters

SOCKETS—See Drill Sleeves and Exten-
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Bethlehem Steel Co., Bethlehem, Pa.
Birdsboro Steel Foundry & Machine Co., Birds-
boro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge
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Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton,
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Buhr Mch. Tool Co., 839 Green St., Ann Arbor
Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Fi-
gueroa, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Columbus Die-Tool & Mch. Co., 955 Cleveland
Ave., Columbus, Ohio
Consolidated Mch. Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Erie Foundry Co., Erie, Pa.
Esper-Lucas Mch. Works, Front St. and Girard
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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit
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 Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
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 Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
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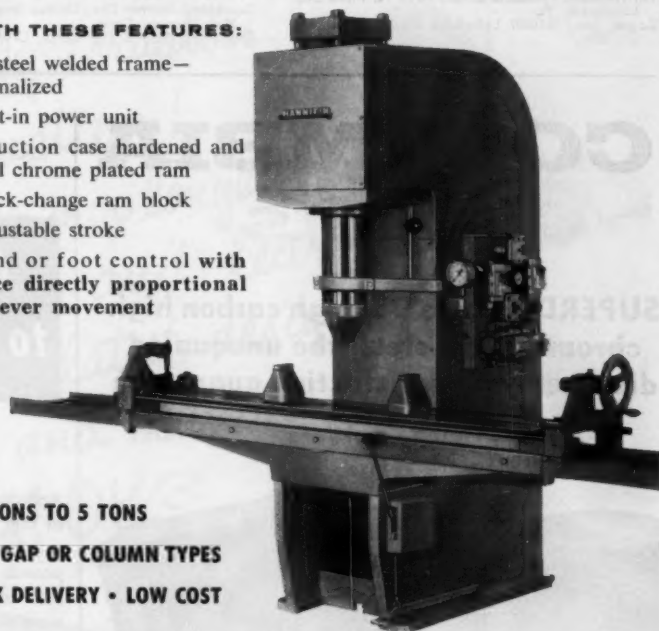
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Sheffield Corp., Box 893, Dayton 1, Ohio.

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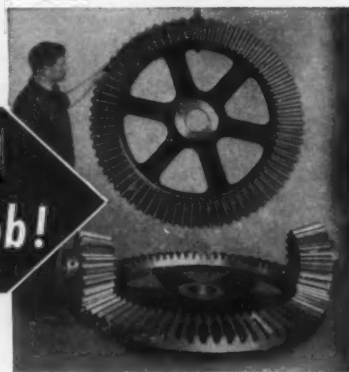
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 Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
 Bridgeport Mch. Co., 500 Lindley St., Bridgeport 6, Conn.
 Burgmaster Corp., 15001 S. Figueroa, Gardena, Calif.
 Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
 Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
 DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
 DoALL Co., Des Plaines, Ill.
 Kennametal, Inc., Latrobe, Penna.
 Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
 Vascology-Ramet Corp., Waukegan, Ill.
 Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
 Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

TOOL MATERIAL, Cast Non-Ferrous Alloy

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
 Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
 Vascology-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, Cemented Carbide

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
 Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
 Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
 DoALL Co., Des Plaines, Ill.
 Kennametal, Inc., Latrobe, Penna.
 Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
 Vascology-Ramet Corp., Waukegan, Ill.
 Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

TOOL MATERIAL, Ceramic

Metal Carbides Corp., Youngstown 12, Ohio.
 Norton Co., 1 New Bond St., Worcester 6, Mass.
 Vascology-Ramet Corp., Waukegan, Ill.

TOOL MATERIAL, High-Speed Steel

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 Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
 Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
 du Mont Corp., Greenfield, Mass.
 Jesop Steel Co., Washington, Penna.
 Vanadium-Alloys Steel Co., Latrobe, Penna.

TRACING ATTACHMENTS

American Tool Works Co., Pearl & Eggleston Aves., Cincinnati 2, Ohio.
 Clausing Div., Atlas Press Co., Kalamazoo, Mich.
 Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
 Gisholt Machine Co., 1209 E. Washington Ave., Madison 10, Wis.
 Gorton Mch. Co., 1321 Racine St., Racine, Wis.
 Jones & Lamson Mch. Co., 512 Clinton St., Springfield, Vt.
 Wales-Strippl, Inc., Akron, N. Y.
 Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

TRANSFER MACHINES

See Multiple-Station Machines

TRANSMISSION, Variable Speed

Barnes, John S. Corp., Rockford, Ill.
 Boston Gear Wks., Quincy, Mass.
 Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus, Ohio.
 Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

TRUCKS, Material Handling

Hamilton Tool Co., 834 So. 9th St., Hamilton, Ohio.

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 Mueller Brass Co., Port Huron 34, Mich.
 Reverse Copper & Brass Inc., 230 Park Ave., New York, N. Y.
 Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

TUBING, Steel

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
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 National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
 Reverse Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
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 Timken Roller Bearing Co., Canton, Ohio

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 Sheffield Corp., Box 893, Dayton 1, Ohio.

ULTRASONIC MCH. TOOLS

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 Logansport Mch. Co., Inc., Logansport, Ind.
 Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

VALVES, Air

Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
 Hydraulic Press Mfg. Div., Mt. Gilead, Ohio.
 Logansport Mch. Co., Inc., Logansport, Ind.
 Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Mich.
 Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
 Skinner Electric Valve Div., New Britain, Conn.
 Tomkins-Johnson Co., Jackson, Mich.

VALVES, Hydraulic

Barnes, John S. Corp., Rockford, Ill.
 Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio.
 Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
 Hydraulic Press Mfg. Div., Mount Gilead, Ohio.
 Logansport Machine, Inc., 801 Center Ave., Logansport, Ind.
 Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

VERNIERS—See Calipers, Vernier; Gages, Vernier**VICES, Machine**

Bridgeport Mch. Co., 500 Lindley St., Bridgeport 6, Conn.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Machine Co., Milling Mch. Div., Marburg Ave., Cincinnati 9, Ohio.
 Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
 Modern Mch. Tool Co., 2005 Losey Ave., Jackson, Mich.
 Universal Engineering Co., Frankenmuth 2, Mich.
 Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

WELDING EQUIPMENT, Arc

Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y.
 General Electric Co., Schenectady, N. Y.
 Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, Ohio.
 Linde Co., 30 E. 42nd St., New York 17, N. Y.

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 Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
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 U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.
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 Greenlee Bros. & Co., 2136-12th St., Rockford, Ill.

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 Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
 Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
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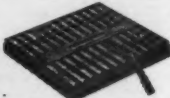
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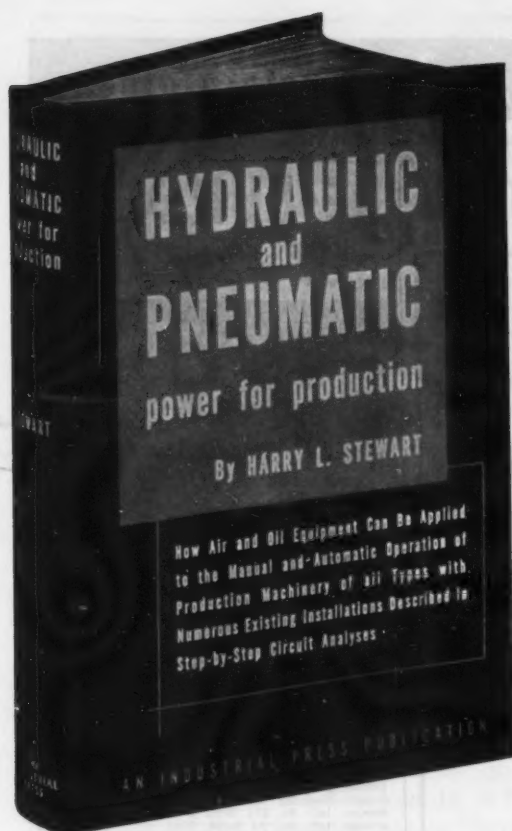
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No. 7 Fellows, 1945
No. 7A Fellows Gear Shaper, belted m.d.
No. 18 Fellows Gear Finishing Machine, m.d.
No. 61A Fellows, m.d., latest type, 1945
No. 645AS Fellows, vee belt drive
No. 645A Fellows, m.d.
No. 70 Cross Deburring Machine, m.d., 1940
No. 72 Fellows H.S. Spur Gear Shaper, m.d.
No. 75 Fellows, H.S., m.d.
No. 75A Fellows H.S. Spur & Helical, m.d.
No. 712 Fellows, m.d.
No. 712SA Fellows, m.d., H.S.
No. 725 Fellows, 1945

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No. 36 Gould & Eberhardt Bevel & Spur Gear Rougher, m.d.
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No. 4B Fellows Gear Burnisher
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No. 5AC Lee-Bradner Heavy Type Gear Generator, m.d.
No. 4-4B" Brown & Sharpe, m.d.
No. 50 Cross Clutch Miller, m.d.
No. 5-60" Brown & Sharpe Gear Cutter, m.d.
W. C. Lips Gear Chamfering, m.d.
No. 712SA Fellows H.S. m.d.

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Type A Barber-Colman, m.d.
Type B Barber-Colman, m.d.
Type T Barber-Colman, m.d., 1912
No. 1 Lee Bradner Universal, m.d.
No. 3 Barber-Colman, m.d., 1945
No. 12 Barber-Colman, double overarm, m.d.

No. 12 Barber-Colman, single overarm, m.d.
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Boring Mill: 4" bar Universal, 60" vert., 1942
Boring Mills 5" Sellers 60" vert., 1941
Broach: 10 ton 34" American vert. duplex
Centering: 6" x 72" No. 56 Sundstrand
Compressor: 868 CFM Sullivan duplex, 125 HP
Drill, Deep Hole: 420 W. F. & John Barnes, 1942
Drill, Multiple: No. 4BL Notes, 36 spdl.
Drill, Hydr.: No. 25 Ex-Call-8, late
Grinder, C'less: No. 12 L-andit, 1948
Grinder, C'less: No. 2 Cincinnati, Rimatic, 1940
Grinder, C'less: No. 2 Cincinnati, Rimatic, 1951
Grinder, Disc: 22" No. 221 Hanchett opposed
Grinder, Int.: No. 271 Heald 4-in, 1951
Grinder, Int.: No. 74 Heald, 1941
Grinder, T&C: No. 2 Cincinnati, 1944
Grinder, Univ.: 10x24 Landis, late
Lathe, Auto.: 8 x 15" Sundstrand
Lathe, Auto.: No. 8 Gisholt, 1950
Lathe: 16" x 54" American P-reamer, 1941
Lathe: 25" x 72" Axelson, 1944 also 25" x 18
Lathe: 60" Lodge & Shipley "Y" 1951
Lathe, turret: 9 1/2" Hole No. 4L Gisholt
Lathe, turret: No. 4 L. L. prest. 1942
Mills, Boring: 60" Gisholt, vert. 90C
Mills, Prd.: No. 33 Sundstrand Flid-Screw, 1942
Mills, Prd.: No. 5-48 Cincinnati, late
Mill: No. 5H K&T, plain, vert. ad., 1941
Mill: No. 3KH K&T vert., 1943
Mill: 42" x 42" x 18" Ingersoll planer type
Planer: 66" Rockford Hydr. open side, 1943
Press: 110 ton No. 675B Oliver, high speed
Press: 125 ton Clearing SS machine, 1943
Press: 150 ton Lake Erie hydr. 1951
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MACHINERY, January, 1960

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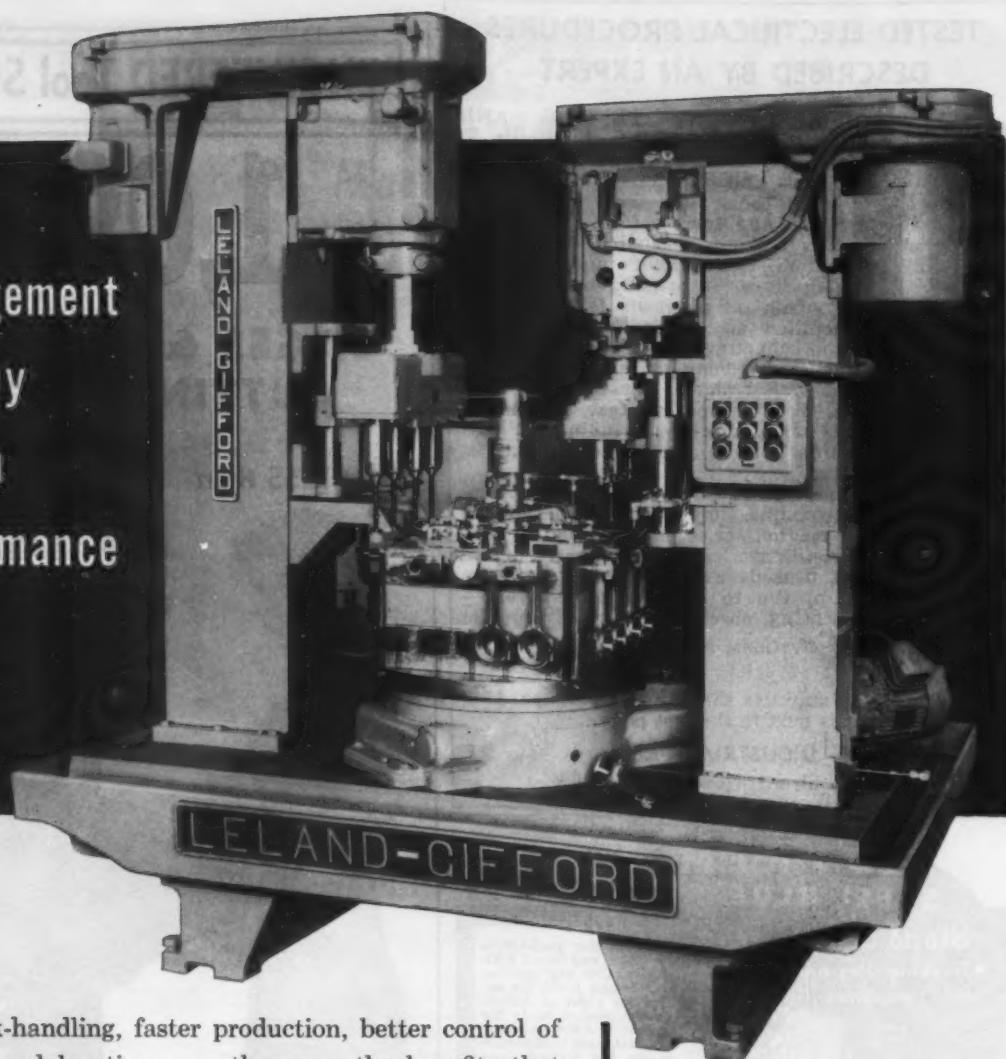
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management
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proven
performance
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this



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***For automatic drilling at its best
be sure to see Leland-Gifford***

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THE JOB: Drill $\frac{1}{4}$ " oil splash hole and $\frac{3}{16}$ " metering hole in connecting rod.

THE MACHINE: A Leland-Gifford two-unit special with one No. 4 and one No. 3 self-contained drilling unit. Index table is loaded with four parts in each station and clamped by hydraulic clamp cylinders. Four-spindle multiple head at left station drills splash holes to depth; directed air jets at rear station clear chips, four-spindle head at right station drills metering holes. Production of 620 pieces per hour is easy at 100% efficiency.

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- More information on products advertised
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3. Mail . . . we'll do the rest.

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CITY ZONE STATE



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This card expires April 1, 1960

FIRST CLASS
Permit No. 53
New York, N. Y.

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MACHINERY

93 WORTH STREET

NEW YORK 13, N.Y.

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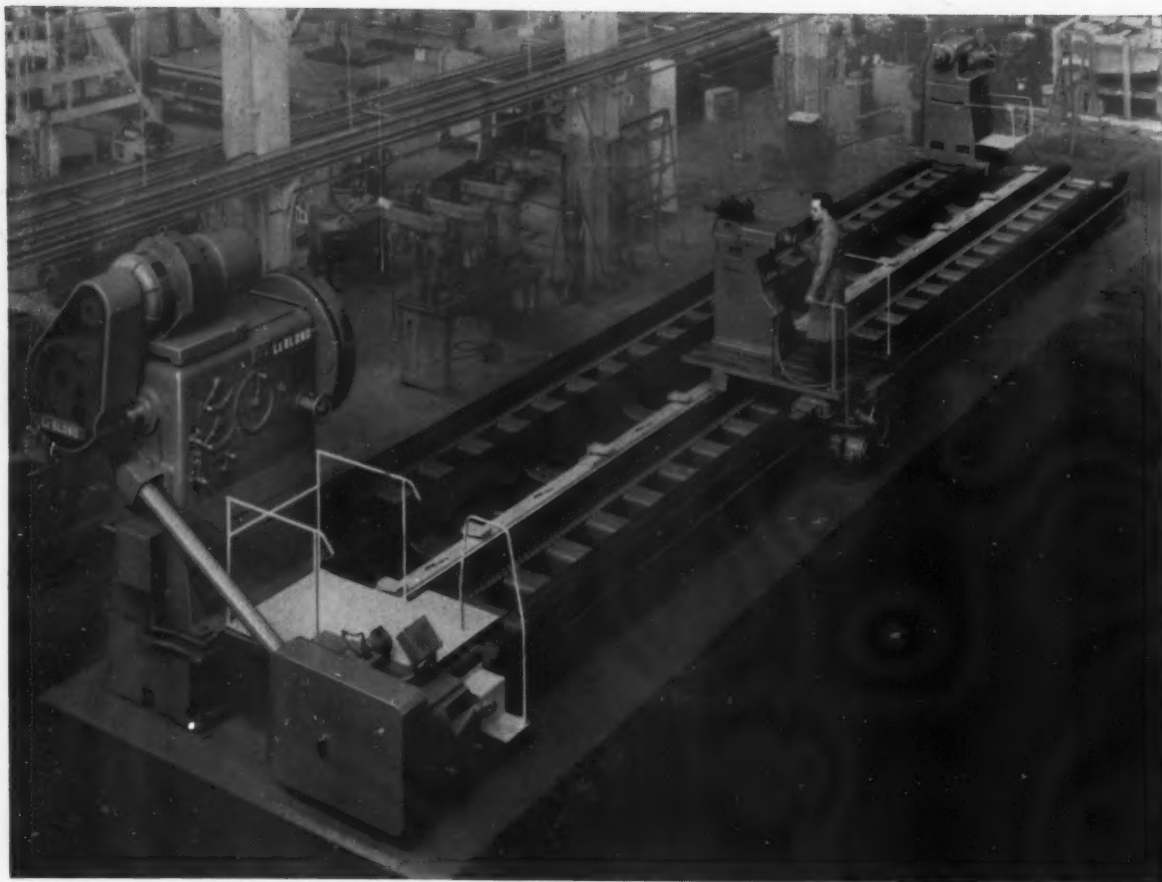
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